Effectiveness of nutrition education in Dutch primary schools

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Abstract

School-based nutrition education programmes have increasingly been used to teach children about nutrition and to provide them with the skills to make healthy food choices. As these programmes differ in content and delivery, it is hard to identify what intervention components and implementation conditions are most effective. Furthermore, as nutrition education is not mandatory in the Netherlands, it is not clear what effects can be achieved with nutrition education in Dutch primary schools. In this thesis therefore two versions of Taste Lessons were evaluated. Taste Lessons is a practice-driven school-based nutrition education programme on taste development, healthy nutrition, and food quality. The programme was evaluated on its aim to increase children's interest in food, and their knowledge and skills regarding healthy and conscious eating behaviour. Furthermore, the influence of adding experiential learning activities and implementation factors on effectiveness are addressed.

The first evaluation study showed that partial implementation of the 10-12 lessons of Taste Lessons (first version) by the teachers during one school year resulted in small increases in psychosocial determinants of healthy eating behaviour. The highest increase was observed in children's knowledge, which persisted six months after the programme. A second evaluation was conducted to study the effectiveness of the revised and shortened version of Taste Lessons (second version) on change in (psychosocial determinants of) vegetable consumption and willingness to taste unfamiliar vegetables. For this study, Taste Lessons with and without additional experiential learning activities were compared. Results from this second study showed, with almost complete implementation of the five lessons of Taste Lessons, similar results as the first effect evaluation. Again with knowledge as the strongest intervention effect. Additional experiential learning activities, such as an extended cooking lesson with a dietician and the parents, an excursion to a grower and a supermarket assignment with the parents, showed more and stronger increases in several psychosocial determinants of vegetable consumption than Taste Lessons without these additional activities. No significant intervention effects were found on children's willingness to taste unfamiliar vegetables during a taste test, and also not on their daily vegetable consumption and food neophobia.

Analyses on process indicators in both studies revealed that teachers and children highly liked Taste Lessons and that children most liked the experiential learning activities. Furthermore, children's programme appreciation and interpersonal communication about the programme activities after the lessons were found to be positively associated with their change in psychosocial determinants.

In conclusion, evaluation of Taste Lessons showed an increase in children's knowledge and several other psychosocial determinants of eating behaviour. Implementation of (additional) experiential learning methods in school-based nutrition education is likely to enhance the intervention's effectiveness, as children mostly liked these activities and children's enthusiasm was the strongest predictor of effectiveness. No effects were found on children's vegetable consumption. To achieve behavioural change, school-based nutrition education should be complemented with a consistent set of changes in children's environment.

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General introduction

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Shaping healthy eating behaviour in children

Importance of healthy eating behaviour in children

Healthy eating behaviour in early childhood is important for children's growth and development [1, 2]. It may protect against the development of overweight and obesity, and against chronic diseases later in life, such as metabolic syndrome, diabetes, and cardiovascular diseases [3, 4]. Moreover, children's eating behaviour may continue into adulthood [5-8]. Most children in the Netherlands, however, do not fulfil the guidelines for healthy nutrition provided by the Dutch Health Council [9]. Also, a study conducted by Cito among Dutch primary schools revealed that children's knowledge on the topic of nutrition and health was far below an acceptable level, and that their knowledge level was correlated with their score on (attitude to) unhealthy eating behaviour [10]. Therefore, children should be encouraged to adopt healthy eating behaviour.

Development of children's eating behaviour

Biologically, children tend to reject unfamiliar foods, a phenomenon called food neophobia [11-13]. Food neophobia can be overcome, however, as taste preferences are shaped mainly by learning [11, 14]. Three major processes have been described by Westenhoefer [14] that modify food acceptance in children; these are also summarised in Contento's overview [15] (Figure 1). The first process

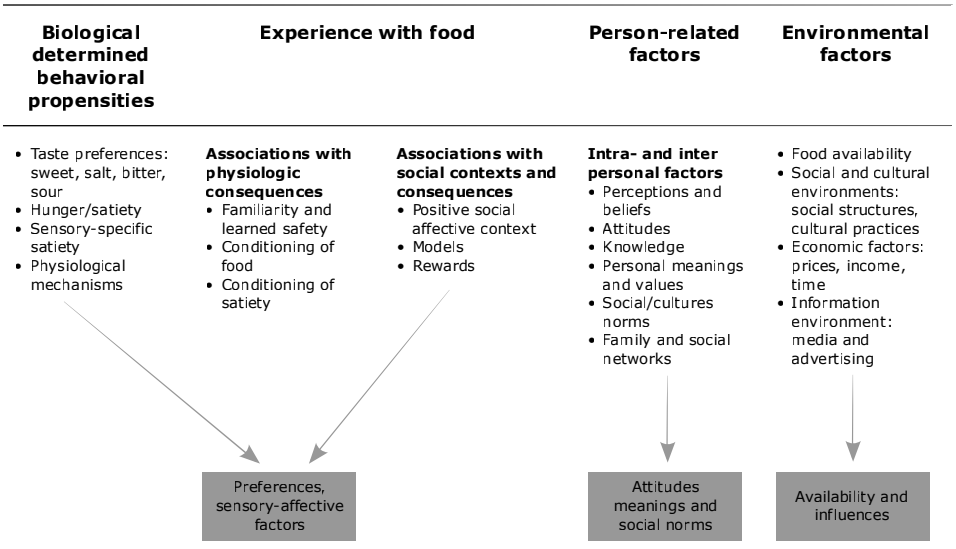

Figure 1. Factors that influence children's eating behaviour [15].

includes repeated exposure to a food, because repeated tasting and eating a food reduces the tendency to reject this food [16-18]. The second process includes modification by social influences, as children learn to prefer foods which are eaten by, for example, their parents and peers [16]. The third process includes associative learning: learning to associate the physiological consequences of the food with the taste of the food and other experiences, resulting in attitudes towards, and beliefs about, the food [16, 19]. The influence of food neophobia on children's willingness to taste an unfamiliar food decreases when the first taste is processed as a positive experience [20]. If these processes are combined, repeatedly offering a food to children in a positive context increases taste acceptance of the food [14, 20]. Also, food neophobia seems to decline when children get older [19, 21], as older children are more willing than younger children to taste unfamiliar foods [18].

Overcoming food neophobia seems to be important for children to adopt healthy eating behaviour [20]. Familiarity with a food increases liking for that food, and familiarity with a variety of foods increases acceptance of other foods [22, 23]. Mustonen et al. [24] found that children with low neophobia were familiar with a larger number of foods and rated all foods more highly in pleasantness than children with high neophobia did. Furthermore, studies have shown that children with high neophobia have a lower diet quality than children with low neophobia [25, 26].

Determinants that influence the development of children's eating behaviour

In addition to the three processes that influence food acceptance, Figure 1 shows that personal and environmental factors play a role in children's willingness to taste unfamiliar foods and in their eating behaviour. Personal (or psychosocial) determinants include for example children's knowledge, attitudes, and perceived norms on healthy eating behaviours. Environmental determinants include for example availability of healthy foods, food advertisement in the media, and policies.

The socio-ecological model [27, 28] further elaborates on personal and environmental determinants that shape children's eating behaviour. This model explains that personal determinants play role on the intrapersonal and the interpersonal level, and environmental determinants on the community and the public policy level (Figure 2). In accordance with Figure 1, intrapersonal determinants include taste preferences, knowledge, and attitudes, whereas interpersonal determinants include parent behaviour (such as own consumption, eating practices, modelling, support), peer influences, and the availability of healthful foods [19, 24, 29-34]. The home environment plays an important role in the

development of children's eating behaviour [35, 36], but actors on the community level, such as the neighbourhood, school, and the media, may influence their eating behaviour as well [14, 19, 32, 37-39]. Moreover, parental influence may decline as the child moves into adolescence [40-42], although parents (especially how they behave) continue to be important for children's eating behaviour [43, 44]. Finally, cultural influences and policies play a role on the community and the public policy level.

School-based nutrition education

The school as setting to intervene in children's eating behaviour

The school setting seems to be an effective environment for teaching children about nutrition and healthy eating [45, 46]. The primary school is a place to reach children from all socio-economic backgrounds as they spend a substantial amount of time at school per week [47, 48]. Moreover, the school provides an educative learning environment in which children acquire knowledge and skills, and learn favourable attitudes and behaviour [3, 49, 50]. The physical environment, policies, curricula, and staff all have the potential to positively influence child health [51]. Teachers can be powerful role models for children [39, 52]. He et al.'s study found that, in China, primary school teachers' health awareness, positive health attitudes, and regular exercising behaviours were all positively associated with their students' healthy eating behaviours [53]. Also, the fact that children are exposed to peer influence at school makes school a promising environment for health education [54]. Contento et al.'s study [55] showed that providing healthy nutrition at school and getting children acquainted with

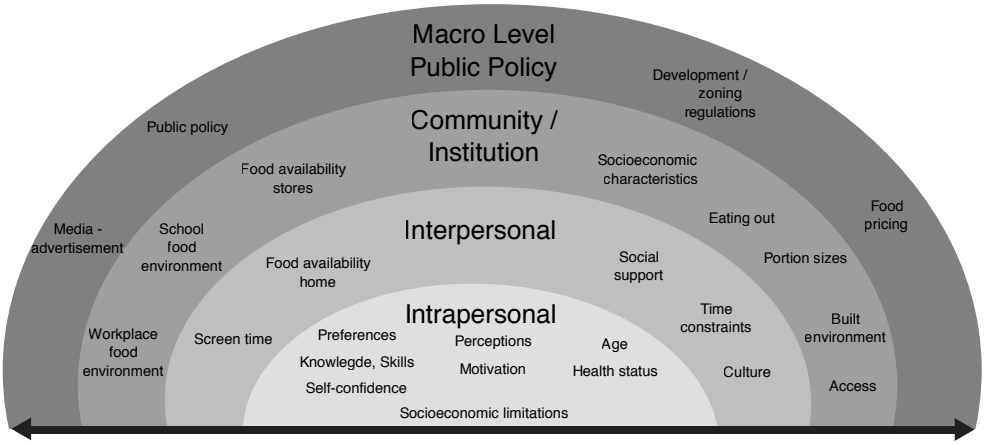

Figure 2. An ecological model of factors influencing diet and physical activity [28].

the taste and preparation of foods resulted in children making healthier food choices. Finally, health education in school is found to have positive effects on children's academic attainment [56, 57]. The literature suggests that education and health are correlated: well-educated children have better health, and children in better health have a higher academic attainment [56, 58].

Approaches, methods, and activities used in school-based nutrition education

Because the school setting seems to be an effective setting for nutrition education, many school-based nutrition programmes have been developed and evaluated in the past few decades [59]. These school-based nutrition interventions have different approaches, aims, and activities to intervene in children's eating behaviour.

Contento et al. [60] described two main approaches in school-based nutrition education research. In the first approach, nutrition education is seen as part of general education, to create food-literate consumers who are able to make nutritious and conscious food choices. In the second approach, nutrition education more specifically aims to change children's eating behaviour in order to enhance health and reduce the risk of chronic disease. Therefore, programmes adopting the first approach might aim mainly at increasing knowledge, attitude, and skills towards healthy and conscious eating behaviour, whereas programmes adopting the second approach aim mainly to actually change children's eating behaviour and body composition (such as BMI and waist circumference).

Aims, methods, and activities may differ between programmes using one or the other approach. A review by Dudley et al. [51] revealed that the following methods and activities are mostly used in school-based nutrition education:

- Contingent reinforcement methods: rewards or incentives given to students in response to desired behaviours.
- Literary abstraction methods: literature read to or by children, whereby a character promotes or exemplifies positive behaviours.
- Games-based methods: games designed to teach new knowledge and promote healthy eating behaviour.
- Web-based methods: internet-based resources or feedback mechanisms are mostly used.
- Cross-curricular methods: programmes delivered across two or more traditional school subjects.
- Enhanced curriculum methods: programmes beyond existing health

curricula delivered by teachers or specialists.

- Experiential learning methods: gardening, cooking, and food preparation activities.
- Parental involvement: active participation or assistance from a parent within or outside the school environment.

Sensory education [61-63] and the provision of heathy foods, usually fruit and vegetables [18, 64, 65], are methods mentioned in other literature.

Effectiveness of school-based nutrition education programmes

The evaluation of school-based nutrition education programmes is complex, and studies show varying effects, from changes in psychosocial determinants to changes in actual eating behaviour [29, 31, 45-48, 51]. As the programmes differ in content and delivery, it is hard to identify the most effective approach, methods, and activities. Little is known yet about what intervention components, offered in what quantity, are most effective in achieving the desired outcomes. However, several suggestions can be found in the literature.

Approach

To enhance the effectiveness of nutrition education, the literature for example suggests that school-based nutrition education programmes should provide not only information on healthy eating behaviour, but also tasting opportunities, and enhance knowledge and skills in relation to making healthy food choices and preparing a healthy meal [45, 60]. Other studies suggest that nutrition education should focus on providing a variety of foods, encouraging children to taste unfamiliar foods [14, 66].

Methods and activities

Peters et al. [67] suggest that programmes are more effective when they use varying teaching methods, including active and interactive assignments for the children in multiple settings. Incorporating the children's active involvement is perceived as an important element of effective nutrition education [68, 69]. Liquori et al. [68] suggest that, on the basis of Piaget's cognitive developmental theory, nutrition education should provide concrete experiences with food rather than focus on abstract concepts, as children's food preferences and acceptance are strongly influenced by associative conditioning from direct experience with foods. Reverdy et al. [61] suggest that repeated exposure to unfamiliar foods during sensory education is more effective than the presentation of cognitive information alone in reducing neophobia. Perhaps related to children's active participation, the literature suggests that nutrition education programmes should be engaging for the children [45]. Children's interest increases learning

and recognition of the need to adopt a healthy eating behaviour [66, 70]. Dazeley et al. [22] suggest that programme success may result from the fun children have while engaging in activities with foods and the positive associations they acquire with the foods as a result.

Experiential-learning activities such as tasting, cooking, and gardening fit these requirements and are therefore promising methods [40, 45, 46, 51, 67, 69, 71]. Children appreciate such activities highly [72-74]. Furthermore, such activities may increase familiarity and positive associations with food [72, 73, 75], and this may result in increased willingness to taste and like particular foods [73, 76, 77]. Dazeley et al. [22] suggest that the higher willingness to taste a food in children who have been involved in growing of the food results from repeated taste exposure, a greater familiarity with the sensory properties, and a greater awareness of the origins of the food. A review by Robinson-Brien et al. [77] shows that programmes including nutrition lessons, gardening activities, and, in some cases, food preparation activities indeed are generally more effective in increasing children's fruit and vegetable intake than nutrition lessons only.

The literature also indicates that programmes may be more effective when the parents are involved [31, 45, 46, 60, 67, 71, 78], but more for younger children than for older children [44, 45, 60]. However, many studies report low levels of parental participation [31, 45, 79], with home activities being more successful than activities outside the home [31, 80]. Not many studies have assessed the added effectiveness of parental involvement [51]. The few that have done so found either positive [81] or no changes [82] in outcomes such as availability of fruit and vegetables at home and vegetable intake. It is unclear how parents should be involved to maximise the effect of school-based nutrition education. A review by Bergstrom et al. [47] reports that some studies suggest that counselling of parents is most effective in improving children's eating behaviour, whereas sending home information is not; other studies, however, suggest that materials sent home is the most feasible and effective way to involve parents [31, 78, 80].

Dose

Finally, the literature indicates that programmes must be of sufficient length and intensity to achieve behavioural change or other desired outcomes [60, 65, 71, 79, 83]. Knai et al. report that the three most successful interventions to increase children's fruit and vegetable intake lasted 12 months or longer [71].

Implementation of school-based nutrition education programmes

Most school-based nutrition education programmes are designed to be implemented by teachers themselves. This means that programme delivery and outcomes depend on the teachers and schools, and thus they are likely

to vary between classes and schools. To enhance the effectiveness of nutrition education programmes, it is important to gain insight into which factors influence programme outcomes by conducting a process evaluation and relating process indicators to the programme outcomes [45, 59, 60, 84-87]. Process evaluations may help to identify what works, for whom, where, when, and why [88]. Inadequate implementation contributes to attenuating the impact of school health education programmes [45, 59]. Few studies, however, have studied the influence of the implementation process on the delivery and effects of nutrition education programmes [79, 84].

With regard to programme delivery, studies have shown that delivered dose varies highly by school and by teacher [79, 88, 89]. In the literature, several factors are reported to influence teachers' delivered dose, including school-, teacher-, child-, and programme-related factors [47, 59, 71, 78, 79, 88, 90-93]. School-related factors include the extent to which a programme fits the school health policy, support for implementation, the decision-making process in the school, priorities and available time, space and budget. Teacher-related factors include perceived relevance and responsibility, perceived effect of the programme, and knowledge, self-efficacy, and intention to implement nutrition education. Child-related factors include motivation, engagement, and responsiveness to the programme activities. Finally, programme-related factors include the feasibility and the flexibility of the programme, providing training and feedback on implementation, and implementation materials.

With regard to programme outcomes, programme appreciation, delivered dose (such as time spent on programme delivery, how many lessons, how many core activities), and quality of implementation (such as the extent to which the programme was delivered in accordance with the teacher manual and what adaptations were made) are perceived as the most influential process indicators [85-87, 94]. Furthermore, teacher characteristics (such as teaching experience, skills, motivation, involvement, and – perceived – school support for implementation) and child-related factors (such as attention and engagement) are perceived as influencing the effect of nutrition education programmes [83, 84, 86, 87, 89, 95]. From research on the effects of mass media campaigns, it seems that interpersonal communication, representing the extent to which people talk about the programme, can be seen as an indicator of children's engagement with the programme [96-98].

The school-based nutrition education programme taste lessons

Nutrition education in the Netherlands

In the Netherlands, children go to primary school between the ages of four and twelve years. Dutch primary schools have eight grades. Going to school is mandatory for every child from the age of five. From then on, skipping school days is not allowed. Parents can choose between a variety of schools, such as schools with a public or religious principle and Montessori or other types of education philosophy.

In the Netherlands, most primary school children bring their own sandwiches for lunch or have lunch at home [99], as generally no school meals are offered. Also, children usually bring their own drink and snack for the morning break. Some schools have adopted a policy of regulating unhealthy snacks brought from home and of eating fruit and vegetables at morning break on one or more days per week (by participating in the European School Fruit Scheme or having a 'Schoolgruiten' policy). However, in a study by Reinaerts et al. in 2006 [74], children reported that they hardly ever brought fruit or vegetables to school and that hardly any attention was paid to fruit and vegetable consumption at school.

Nutrition education in primary schools has to compete with many other subjects, as schools have a busy schedule with a major focus on core subjects [10, 56, 91], and only general learning outcomes with regard to food, nutrition, and health are formulated [100]. A study conducted by Cito in 2010 among 334 teachers in 137 schools revealed that three-quarters of the teachers felt that there was not sufficient information for nutrition education available and that (clear) learning goals were lacking [10]. The researchers also came to the conclusion that there was no consistent and balanced supply of nutrition education material, as different aspects of nutrition education were scattered over existing elements of biology and science education [10].

The same study by Cito revealed that teachers spent on average 7–8 hours per year on nutrition education [10]. Half of the teachers integrated nutrition education in the core biology subject, nearly half considered it as a separate project, and a few teachers did not pay attention to it at all. About a quarter of the teachers took their pupils on excursions (such as to a farm or a supermarket) or let the children write or present on the subject of nutrition. Furthermore, a third of the teachers reported setting home assignments, and a small percentage of the teachers had invited someone to talk about nutrition in class.

Currently, there are several school-based national nutrition education programmes available for use in Dutch primary schools. These programmes include [101]:

- Smaaklessen (Taste Lessons): lessons, smartboard activities, and suggestions for additional activities for all grades of the primary school (4–12-year-olds), with the aim of promoting healthy and conscious food choices.
- Lekker Fit!: lessons and physical activity suggestions for all grades in primary school (4–12-year-olds), with the aim of promoting physical activity and healthy eating behaviour.
- Ik eet het beter: an Albert Heijn supermarket platform with various activities for children aged 8–12 years to enhance healthy eating behaviour.
- SuperShopper: lessons, an online game, and an excursion to the supermarket for all children aged 10–12 years to promote healthy and conscious food choices.
- SuperChefs: cooking lessons to enable children aged 10–12 years to prepare a healthy meal.
- EU-Schoolfruit (European School Fruit Scheme): provision of fruit and vegetables, lessons, and smartboard activities for all grades in primary school (4–12-year-olds), with the aim of encouraging children to eat fruit and vegetables in class.

Taste Lessons

Taste Lessons (in Dutch: Smaaklessen) is a Dutch school-based nutrition education programme for all primary-school grades (grades 1–8, children aged 4–12 years). The programme aims to raise children's interest in food by providing new experiences with taste and food products in a positive and playful way. With these new experiences, children learn about taste, nutrition in relation to health, and food quality. Taste Lessons is designed on the idea that teaching children about conscious and healthy eating behaviour in a playful way might be more effective than providing children with information in a more theoretical way. The ultimate goal of the programme is to enable children to make healthy and conscious food choices when they are older, and to decrease the prevalence of overweight and lifestyle-related diseases.

The programme, initiated by TV cook Pierre Wind, was developed in 2006 by the Dutch Nutrition Centre and Wageningen University and from 2006 to 2013 financed by the Ministry of Economic Affairs (called Ministry of Agriculture,

Nature, and Food Quality in 2006). In 2013, Taste Lessons became part of the Food Education Platform, in which Taste Lessons is financed by both government and companies in a public–private collaboration (a Top consortia Knowledge and Innovation (TKI) scheme).

Before 2013, the programme consisted of 10–12 lessons per two grades (for grades 1–2, 3–4, 5–6, and 7–8) discussing various topics in relation to three themes: 'taste', 'nutrition and health', and 'food quality'. Each lesson took 45 minutes to two hours and consisted of a number of varied activities including plenary group talks, taste testing, conducting experiments, cooking, and homework assignments. Some lessons included home assignments which children had to complete with their parents at home. For each lesson, tips for extra activities were also provided, such as visiting a farm. Teachers were invited to attend an introductory workshop when the school registered for Taste Lessons. During this introductory workshop, teachers were trained in how to implement the lessons. At the end of the workshop, the school received a toolkit with the teacher manuals and materials.

In 2013, the lesson materials were rearranged into five lessons for every grade, with each lesson focusing on one of the themes: 'taste development', 'eating healthily', 'food production', 'consumer skills', and 'cooking'. Each lesson takes on average 45 minutes and includes the same types of activities as the former version.

Since Taste Lessons became part of the Food Education Platform, 'Taste Missions' have been introduced. This is a format in which Taste Lessons can be extended with a coherent set of additional hands-on activities for every food group. Taste Missions' aim is to repeat and deepen children's understanding of the lessons by involving children in each step of the food chain with various hands-on activities and by more extensively engaging parents in the programme.

The programme materials are designed for implementation by teachers themselves. Teachers are free to spread the lessons over the year or cluster them in a project week. The programme activities, objectives, and possible implementation factors are summarised in the Intervention Logic Model (Figure 3): a causal model that links programme implementation with its effectiveness.

Rationale, objective, and outline of this thesis

Rationale for this thesis

Most health promotion programmes are developed in universities, using theories and scientific evidence. The question about these programmes is whether they are feasible to implement and appreciated in practice. Taste Lessons is a programme which worked the other way around. The programme has been developed and used in practice for almost a decade, and a third of the primary schools in the Netherlands have registered for it, but no effect evaluation of the programme has been conducted.

Since the programme aims to increase children's interest in food and to increase their knowledge and skills regarding healthy and conscious eating behaviour, children exposed to Taste Lessons are expected to increase in psychosocial determinants of healthy and conscious eating behaviour (short-term outcomes), and maybe also in their willingness to taste unfamiliar foods and eating behaviour (mid-term outcomes; Figure 3).

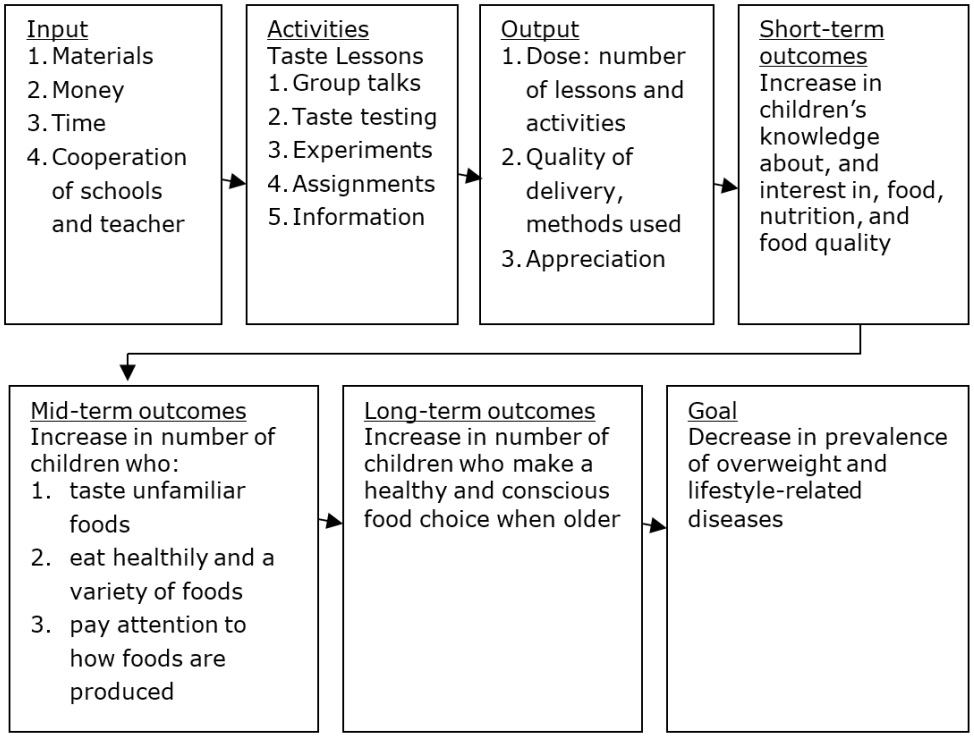

Figure 3. Intervention Logic Model.

Objectives and studies conducted

For this thesis, two studies were performed to investigate the effectiveness of Taste Lessons, and the influence of the input, activities, and output on its effectiveness.

Study I

In school year 2011–2012, an effect and process evaluation of Taste Lessons was conducted in which teachers in the intervention group implemented the first version of Taste Lessons, consisting of 10–12 lessons per every two grades. In this quasi-experimental study, children in an intervention or a control group filled out an effect evaluation questionnaire before and after implementation of Taste Lessons. Children and their teacher in the intervention group also filled out a process evaluation questionnaire after implementation of Taste Lessons. The objective of this study was to answer the following two questions:

- Is Taste Lessons effective in increasing children's psychosocial determinants of eating healthily and a variety of foods?
- Can process indicators unravel the extent of the effect of Taste Lessons on children's psychosocial determinants?

Study 2

In school year 2013–2014, an effect and process evaluation was conducted on the new version of Taste Lessons. In this study, a similar design was used as in the first study, but the intervention group now was divided into children who received Taste Lessons Vegetable Menu (Taste Lessons with additional experiential learning activities in a vegetable project) and children receiving the five lessons of Taste Lessons only. Finally, children in the intervention and the control group not only completed a questionnaire on psychosocial determinants and actual behaviour, but also took part in a taste test to more objectively assess their willingness to taste unfamiliar vegetables. The objective of this study was to answer the following three questions:

- Does Taste Lessons with additional experiential learning activities increase the effectiveness of Taste Lessons on children's psychosocial determinants of vegetable consumption?
- Is Taste Lessons with and without additional experiential learning activities effective in increasing children's actual willingness to taste unfamiliar vegetables and their daily vegetable consumption, and in decreasing their food neophobia?
- How do school-, teacher-, parent-, and child-related implementation factors influence the effectiveness of Taste Lessons?

1

Outline of this thesis

This thesis starts with two chapters on the results of the first effect and process evaluation of Taste Lessons, conducted in school year 2011–2012. Chapter two shows the results of the effect evaluation on increasing children's psychosocial determinants of healthy eating behaviour. Chapter three describes how several process indicators are associated with the outcomes of the effect evaluation. The thesis then continues with three chapters with results of the effect and process evaluation on the new version of Taste Lessons with and without additional experiential learning activities. Chapter four and chapter five show the results of the effect evaluation on the psychosocial determinants of vegetable consumption and actual behaviour (willingness to taste unfamiliar vegetables, daily vegetable consumption, and food neophobia), respectively, in which the value of additional experiential learning activities is studied. In chapter six, associations between school, teacher, parent, and child related implementation factors and the effectiveness of Taste Lessons with and without additional experiential learning activities are presented. The thesis ends with a general discussion (chapter seven) of the results found in the studies, including methodological issues and implications for future research and practice.

References

1. Bellisle F. Child nutrition and growth: butterfly effects? British Journal of Nutrition. 2008;99(SupplementS1):S40-S5.
2. Uauy R, Kain J, Mericq V, Rojas J, Corvalán C. Nutrition, child growth, and chronic disease prevention. Annals of Medicine. 2008;40(1):11-20.
3. Dehghan M, Akhtar-Danesh N, Merchant A. Childhood obesity, prevalence and prevention. Nutrition Journal. 2005;4(1):24.
4. Bammann K, Peplies J, Pigeot I, Ahrens W. IDEFICS: a multicenter European project on diet- and lifestyle-related disorders in children. Medizinische Klinik (Munich, Germany: 1983). 2007;102(3):230-5.
5. Neumark-Sztainer D, Wall M, Larson NI, Eisenberg ME, Loth K. Dieting and disordered eating behaviors from adolescence to young adulthood: findings from a 10-year longitudinal study. Journal of the American Dietetic Association. 2011;111(7):1004-11.
6. Nicklaus S, Remy E. Early origins of overeating: tracking between early food habits and later eating patterns. Current Obesity Reports. 2013;2(2):179-84.
7. Lake AA, Mathers JC, Rugg-Gunn AJ, Adamson AJ. Longitudinal change in food habits between adolescence (11–12 years) and adulthood (32–33 years): the ASH30 Study. J Public Health (Oxf). 2006;28(1):10-16.
8. Craigie AM, Lake AA, Kelly SA, Adamson AJ, Mathers JC. Tracking of obesity-related behaviours from childhood to adulthood: a systematic review. Maturitas. 2011;70(3):266-84.
9. van Rossum CT, Fransen HP, Verkaik-Kloosterman J, Buurma-Rethans EJ, Ocké MC. Dutch national food consumption survey 2007-2010. Diet of children and adults aged 7 to 69 years. Bilthoven: RIVM, 2011.
10. Thijssen J, Schoot Fvd, Hemker B. Balans van het biologieonderwijs aan het einde van de basisschool 4 - Extra aandachtsgebied Voeding en gezondheid - Uitkomsten van de vierde peiling in 2010. Periodieke Peiling van het Onderwijsniveau. 2011.
11. Birch LL. Development of food acceptance patterns in the first years of life. The Proceedings of the Nutrition Society. 1998;57(4):617-24.
12. Birch LL. Developmental aspects of eating. In: Sepherd R, editor. Handbook of Psychophysiology of Human Eating. Chichester: Wiley; 1989. pp. 179-203.
13. Birch LL. Development of food preferences. Annual Review of Nutrition. 1999;19:41-62.
14. Westenhoefer J. Establishing good dietary habits – capturing the minds of children. Public Health Nutr. 2001;4(1A):125-9.
15. Contento IR. Nutrition Education: Linking Research, Theory, and Practice. Burlington, MA: Jones & Barlett Learning; 2007.
16. Westenhoefer J. Establishing dietary habits during childhood for long-term weight control. Ann Nutr Metab. 2002;46 Suppl 1:18-23.
17. Nicklaus S, Boggio V, Chabanet C, Issanchou S. A prospective study of food preferences in childhood. Food Quality and Preference. 2004;15(7–8):805-18.
18. Laureati M, Bergamaschi V, Pagliarini E. School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruits and vegetables. Appetite. 2014;83(0):26-32.
19. Drewnowski A, Henderson SA, Driscoll A, Rolls BJ. The dietary variety score: assessing diet quality in healthy young and older adults. J Am Diet Assoc. 1997;97(3):266-71.
20. Dovey TM, Staples PA, Gibson EL, Halford JCG. Food neophobia and 'picky/fussy' eating in children: a review. Appetite. 2008;50(2–3):181-93.
21. Mustonen S, Tuorila H. Sensory education decreases food neophobia score and encourages trying unfamiliar foods in 8–12-year-old children. Food Quality and Preference. 2010;21(4):353-60.
22. Dazeley P, Houston-Price C, Hill C. Should healthy eating programmes incorporate interaction with foods in different sensory modalities? A review of the evidence. British Journal of Nutrition. 2012;108(05):769-77.
23. Chen Q, Goto K, Wolff C, Bianco-Simeral S, Gruneisen K, Gray K. Cooking up diversity. Impact of a multicomponent, multicultural, experiential intervention on food and cooking behaviors among elementary-school students from low-income ethnically diverse families. Appetite. 2014;80(0):114-22.
24. Mustonen S, Oerlemans P, Tuorila H. Familiarity with and affective responses to foods in 8–11-year-old children. The role of food neophobia and parental education. Appetite. 2012;58(3):777-80.

25. Falciglia GA, Couch SC, Gribble LS, Pabst SM, Frank R. Food neophobia in childhood affects dietary variety. Journal of the American Dietetic Association. 2000;100(12):1474-81.
26. Zalilah M, Khor G, Mirnalini K, Sarina S. Food neophobia and nutritional outcomes in primary school-children. Journal of Community Nutrition. 2005;7(3):121-9.
27. McLeroy KR, Bibeau D, Steckler A, Glanz K. An ecological perspective on health promotion programs. Health Education & Behavior. 1988;15(4):351-77.
28. Fitzgerald N, Spaccarotella K. Barriers to a healthy lifestyle: from individuals to public policy—an ecological perspective. Journal of Extension. 2009;47(1):1-8.
29. Evans CE, Christian MS, Cleghorn CL, Greenwood DC, Cade JE. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. The American Journal of Clinical Nutrition. 2012;96(4):889-901.
30. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I. Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. British Journal of Nutrition. 2008;99(SupplementS1):S7-S14.
31. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. Journal of Human Nutrition and Dietetics. 2005;18(6):431-43.
32. De Bourdeaudhuij I, Klepp KI, Due P, Rodrigo CP, de Almeida M, Wind M, et al. Reliability and validity of a questionnaire to measure personal, social and environmental correlates of fruit and vegetable intake in 10-11-year-old children in five European countries. Public Health Nutrition. 2005;8(2):189-200.
33. Beck J, De Witt P, McNally J, Siegfried S, Hill JO, Stroebele-Benschop N. Predictors of meeting physical activity and fruit and vegetable recommendations in 9–11-year-old children. Health Education Journal. 2015; 74(2):183-196.
34. Lotrean LM, Tutui I. Individual and familial factors associated with fruit and vegetable intake among 11- to 14-year-old Romanian school children. Health Soc Care Community. 2015;23(5):541-9.
35. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. Pediatrics. 1998;101(3 Pt 2):539-49.
36. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home food environment in relation to children's diet quality and weight status. Journal of the Academy of Nutrition and Dietetics. 2014;114(10):1569-79.e1.
37. Rozin P. The role of learning in the acquisition of food preferences by humans. In: Shepherd R, editor. Handbook of the Psychophysiology of Human Eating. Chichester: Wiley; 1989. pp. 205-27.
38. Chan K, Prendergast G, Grønhøj A, Bech-Larsen T. The role of socializing agents in communicating healthy eating to adolescents: a cross-cultural study. Journal of International Consumer Marketing. 2010;23(1):59-74.
39. Grosso G, Mistretta A, Turconi G, Cena H, Roggi C, Galvano F. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutrition. 2013;16(10):1827-36.
40. Wang MC, Rauzon S, Studer N, Martin AC, Craig L, Merlo C, et al. Exposure to a comprehensive school intervention increases vegetable consumption. Journal of Adolescent Health. 2010;47(1):74-82.
41. Nader PR, Stone EJ, Lytle LA, Perry CL, Osganian SK, Kelder S, et al. Three-year maintenance of improved diet and physical activity: the CATCH cohort. Child and Adolescent Trial for Cardiovascular Health. Archives of Pediatrics & Adolescent Medicine. 1999;153(7):695-704.
42. te Velde S, ChinApaw M, De Bourdeaudhuij I, Bere E, Maes L, Moreno L, et al. Parents and friends both matter: simultaneous and interactive influences of parents and friends on European schoolchildren's energy balance-related behaviours – the ENERGY cross-sectional study. International Journal of Behavioral Nutrition and Physical Activity. 2014;11(1):1-17.
43. Pedersen S, Grønhøj A, Thøgersen J. Following family or friends. Social norms in adolescent healthy eating. Appetite. 2015;86:54-60.
44. Lehto E, Ray C, Haukkala A, Yngve A, Thorsdottir I, Roos E. Predicting gender differences in liking for vegetables and preference for a variety of vegetables among 11-year-old children. Appetite. 2015;95:285-92.
45. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1A):131-9.

46. Van Cauwenberghe E, Maes L, Spittaels H, van Lenthe FJ, Brug J, Oppert JM, et al. Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. The British Journal of Nutrition. 2010;103(6):781-97.
47. Bergstrom H, Haggard U, Norman A, Sundblom E, Schafer Elinder L, Nyberg G. Factors influencing the implementation of a school-based parental support programme to promote health-related behaviours–interviews with teachers and parents. BMC Public Health. 2015;15:541.
48. Amini M, Djazayery A, Majdzadeh R, Taghdisi M-H, Jazayeri S. Effect of school-based interventions to control childhood obesity: a review of reviews. International Journal of Preventive Medicine. 2015;6.
49. Bartholomew LK. Planning Health Promotion Programs: An Intervention Mapping Approach. San Francisco, CA: Jossey-Bass; 2011.
50. Black JL, Velazquez CE, Ahmadi N, Chapman GE, Carten S, Edward J, et al. Sustainability and public health nutrition at school: assessing the integration of healthy and environmentally sustainable food initiatives in Vancouver schools. Public Health Nutrition. 2015:1-13.
51. Dudley D, Cotton W, Peralta L. Teaching approaches and strategies that promote healthy eating in primary school children: a systematic review and meta-analysis. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):28.
52. Hendy HM, Raudenbush B. Effectiveness of teacher modeling to encourage food acceptance in preschool children. Appetite. 2000;34(1):61-76.
53. He L, Zhai Y, Engelgau M, Li W, Qian H, Si X, et al. Association of children's eating behaviors with parental education, and teachers' health awareness, attitudes and behaviors: a national school-based survey in China. European Journal of Public Health. 2014;24(6):880-7.
54. Sormunen M, Tossavainen K, Turunen H. Parental perceptions of the roles of home and school in health education for elementary school children in Finland. Health Promotion International. 2013; 28(2):244-56.
55. Contento I. BG, Bronner Y., Lytle L., Maloney S., Olson C. and Swadener S. The effectiveness of nutrition education and implications for nutrition education policy, programs, and research: a review of research. Journal of Nutrition Education 1995;27(6):277-418.
56. Bonell C, Humphrey N, Fletcher A, Moore L, Anderson R, Campbell R. Why schools should promote students' health and wellbeing. BMJ. 2014; 348(13).
57. Murray NG, Low BJ, Hollis C, Cross AW, Davis SM. Coordinated school health programs and academic achievement: a systematic review of the literature. Journal of School Health. 2007;77(9):589-600.
58. Suhrcke M, de Paz Nieves C. impact of Health and Health Behaviours on Educational Outcomes in High Income Countries: A Review of the Evidence. Copenhagen: WHO, Regional Office for Europe; 2011.
59. van Nassau F, Singh AS, van Mechelen W, Brug J, Chinapaw MJM. Implementation evaluation of school-based obesity prevention programmes in youth; how, what and why? Public Health Nutrition. 2015;18(09):1531-4.
60. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
61. Reverdy C, Chesnel F, Schlich P, Köster EP, Lange C. Effect of sensory education on willingness to taste novel food in children. Appetite. 2008;51(1):156-65.
62. Reverdy C, Schlich P, Köster EP, Ginon E, Lange C. Effect of sensory education on food preferences in children. Food Quality and Preference. 2010;21(7):794-804.
63. Mustonen S, Rantanen R, Tuorila H. Effect of sensory education on school children's food perception: a 2-year follow-up study. Food Quality and Preference. 2009;20(3):230-40.
64. Te Velde SJ, Brug J, Wind M, Hildonen C, Bjelland M, Pérez-Rodrigo C, et al. Effects of a comprehensive fruit- and vegetable-promoting school-based intervention in three European countries: the Pro Children Study. The British Journal of Nutrition. 2008;99(4):893-903.
65. Anderson A, Porteous L, Foster E, Higgins C, Stead M, Hetherington M, et al. The impact of a school-based nutrition education intervention on dietary intake and cognitive and attitudinal variables relating to fruits and vegetables. Public Health Nutrition. 2005;8(06):650-6.
66. Cheng FW, Monnat SM, Lohse B. Middle school-aged child enjoyment of food tastings predicted interest in nutrition education on osteoporosis prevention. Journal of School Health. 2015;85(7):467-76.

67. Peters LWH, Kok G, Ten Dam GTM, Buijs GJ, Paulussen TGWM. Effective elements of school health promotion across behavioral domains: a systematic review of reviews. BMC Public Health. 2009;9:182.
68. Liquori T, Koch PD, Contento I, Castle J. The cookshop program: outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. Journal of Nutrition Education. 1998;30(5):302-13.
69. Jones M, Dailami N, Weitkamp E, Salmon D, Kimberlee R, Morley A, et al. Food sustainability education as a route to healthier eating: evaluation of a multi-component school programme in English primary schools. Health Education Research. 2012;27(3):448-58.
70. Schraw G, Flowerday T, Lehman S. Increasing situational interest in the classroom. Educational Psychology Review. 2001;13(3):211-24.
71. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: a systematic review. Preventive Medicine. 2006;42(2):85-95.
72. van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. Appetite. 2014;79(0):18-24.
73. Heim S, Stang J, Ireland M. A garden pilot project enhances fruit and vegetable consumption among children. Journal of the American Dietetic Association. 2009;109(7):1220-6.
74. Reinaerts E, Nooijer Jd, Kar Avd, Vries Nd. Development of a school-based intervention to promote fruit and vegetable consumption: exploring perceptions among 4-to-12-year old children and their parents. Health Education. 2006;106(5):345-56.
75. Ensaff H, Canavon C, Crawford R, Barker M. A qualitative study of a food intervention in a primary school: pupils as agents of change. Appetite. 2015;95:455-65.
76. Hersch D, Perdue L, Ambroz T, Boucher JL. The impact of cooking classes on food-related preferences, attitudes, and behaviors of school-aged children: a systematic review of the evidence, 2003–2014. Preventing Chronic Disease. 2014;11:E193. doi?
77. Robinson-O'Brien R, Story M, Heim S. Impact of garden-based youth nutrition intervention programs: a review. Journal of the American Dietetic Association. 2009;109(2):273-80.
78. Stang J, Story M, Kalina B. Nutrition education in Minnesota public schools: perceptions and practices of teachers. Journal of Nutrition Education. 1998;30(6):396-404.
79. Langford R, Bonell C, Jones H, Campbell R. Obesity prevention and the health promoting schools framework: essential components and barriers to success. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):1-17.
80. Blom-Hoffman J, Wilcox KR, Dunn L, Leff SS, Power TJ. Family involvement in school-based health promotion: bringing nutrition information home. School Psychology Review. 2008;37(4):567-77.
81. Wind M, Bjelland M, Pérez-Rodrigo C, te Velde SJ, Hildonen C, Bere E, et al. Appreciation and implementation of a school-based intervention are associated with changes in fruit and vegetable intake in 10- to 13-year old schoolchildren—the Pro Children study. Health Education Research. 2008;23(6):997-1007.
82. Bere E, Veierød MB, Bjelland M, Klepp K-I. Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM). Health Education Research. 2006;21(2):258-67.
83. Jaenke RL, Collins CE, Morgan PJ, Lubans DR, Saunders KL, Warren JM. The impact of a school garden and cooking program on boys' and girls' fruit and vegetable preferences, taste rating, and intake. Health Education & Behavior. 2012;39(2):131-41.
84. Gray HL, Contento IR, Koch PA. Linking implementation process to intervention outcomes in a middle school obesity prevention curriculum, 'Choice, Control and Change'. Health Education Research. 2015;30(2):248-61.
85. Steckler A, Linnan L. Process evaluation for public health interventions and research, San Francisco, CA: Jossey-Bass; 2002.
86. Durlak J, DuPre E. Implementation matters: a review of research on the influence of implementation on program outcomes and the factors affecting implementation. American Journal of Community Psychology. 2008;41(3):327-50.
87. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Health Education Research. 2005;20(3):308-13.
88. Aarestrup AK, Suldrup Jorgensen T, Jorgensen SE, Hoelscher DM, Due P, Krolner R. Implementation of strategies to increase adolescents' access to fruit and vegetables at school: process evaluation findings from the Boost study. BMC Public Health. 2015;15:86.

89. Rockoff JE. The impact of individual teachers on student achievement: evidence from panel data. The American Economic Review. 2004;94(2):247-52.
90. Bessems KMHH, van Assema P, Paulussen TWGM, de Vries NK. Evaluation of an adoption strategy for a healthy diet programme for lower vocational schools. Health Education Research. 2011b;26(1):89-105.
91. Martens M, Sluis Mvd. Smaaklessen - Een procesevaluatie onder docenten, leerlingen, partners en Regionale steunpunten. Amsterdam: ResCon, research & consultancy; 2011.
92. Friend S, Flattum CF, Simpson D, Nederhoff DM, Neumark-Sztainer D. The researchers have left the building: what contributes to sustaining school-based interventions following the conclusion of formal research support? Journal of School Health. 2014;84(5):326-33.
93. Britten P, Lai MK. Structural analysis of the relationships among elementary teachers' training, self-efficacy, and time spent teaching nutrition. Journal of Nutrition Education. 1998;30(4):218-24.
94. Saunders RP, Evans MH, Joshi P. Developing a process-evaluation plan for assessing health promotion program implementation: a how-to guide. Health Promot Pract. 2005;6(2):134-47.
95. Roorda DL, Koomen HMY, Spilt JL, Oort FJ. The influence of affective teacher–student relationships on students' school engagement and achievement: a meta-analytic approach. Review of Educational Research. 2011;81(4):493-529.
96. van den Putte B, Yzer M, Southwell BG, de Bruijn G-J, Willemsen MC. Interpersonal communication as an indirect pathway for the effect of antismoking media content on smoking cessation. J Health Commun. 2011;16(5):470-85.
97. Dunlop SM, Kashima Y, Wakefield M. Predictors and consequences of conversations about health promoting media messages. Communication Monographs. 2010;77(4):518-39.
98. Hendriks H, van den Putte B, de Bruijn G-J, de Vreese CH. Predicting health: the interplay between interpersonal communication and health campaigns. J Health Commun. 2014;19(5):625-36.
99. Fries MCE, Veldwijk J, Haveman-Nies A, Bemelmans W, Wijga A. Onderzoek naar de inhoud van lunchtrommels. Voeding Nu. 2011.
100. Snel J. Voorstel voor doorlopende leerlijn 'Hanteren van een gezond en duurzaam voedingspatroon' voor 4 tot 18-jarigen in primair, voortgezet en onderbouw middelbaar beroepsonderwijs. Den Haag: Voedingscentrum; 2012.
101. RIVM Centrum Gezond Leven, Loketgezondleven.nl, https://www.loketgezondleven.nl; 2015 [accessed 29-09-2015]

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Effect of the Dutch school-based education programme Taste Lessons on psychosocial determinants of taste acceptance and healthy eating

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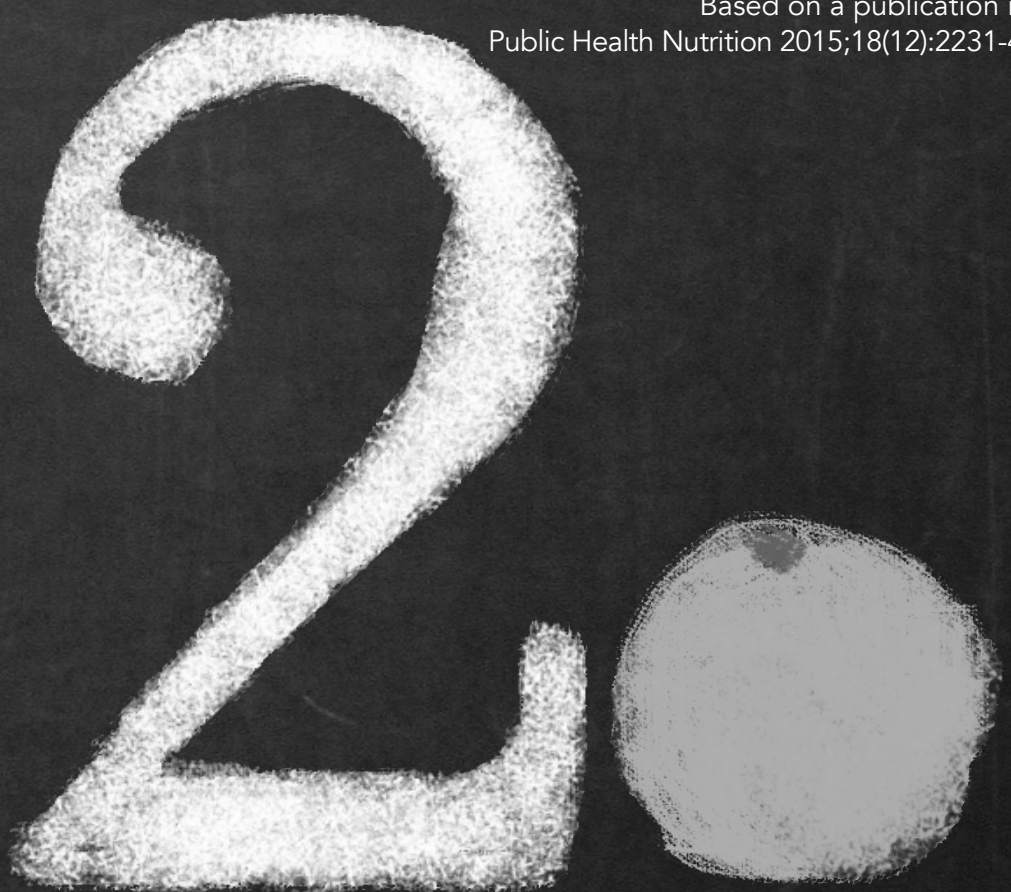

Abstract

Objective

To assess the effect of the Dutch school-based education programme Taste Lessons on children's psychosocial determinants of tasting unfamiliar foods and eating healthily and a variety of foods.

Methods

In a quasi-experimental study design, 1183 children (9-12 years old) in 49 classes of 21 primary schools participated in an intervention or control group. Data on psychosocial determinants were collected at baseline, four weeks and six months after the intervention. Children completed consecutively three questionnaires in which knowledge, awareness, skills, attitude, emotion, subjective norm and intention were assessed towards the two target behaviours. Teachers implemented on average a third of the programme activities. Multilevel regression analyses were conducted to compare individual changes in the determinants in the intervention group with those in the control group, corrected for children's sex and age. Effect sizes were expressed as Cohen's d.

Results

The intervention group showed a higher increase in knowledge (d=0.3, $p<0.01$), which persisted after six months (d=0.2, $p<0.05$). After four weeks, the intervention group showed a higher increase in number of foods known (d=0.2, $p<0.05$) and tasted (d=0.2, $p<0.05$), subjective norm of the teacher (d=0.2, $p<0.05$) and intention (d=0.2, $p<0.05$) towards the target behaviours.

Conclusions

Partial implementation of Taste Lessons during one school year showed small short-term effects on increasing psychosocial determinants of tasting unfamiliar foods and eating healthily and a variety of foods. Full and repeated implementation of Taste Lessons in subsequent years might result in larger effects.

Introduction

A healthy eating pattern in early childhood is crucial for adequate growth and development of children [1, 2]. Furthermore, nutrition in childhood plays an important role in the development of chronic diseases later in life, such as metabolic syndrome, diabetes and CVD [3, 4]. Dietary variety can be seen as an indicator of a healthy eating pattern. Consuming a variety of foods helps to ensure an adequate intake of nutrients and other beneficial substances [5-9]. Research shows that a greater dietary variety is associated with a higher consumption of fruit and vegetables [5], a lower risk of chronic diseases [9] and a lower mortality risk [7]. Therefore, children must be encouraged to adopt a healthy and varied eating pattern.

Biologically, children tend to reject unfamiliar foods, a phenomenon called food neophobia [10-12]. Food neophobia can, however, be overruled, as taste preferences are mainly shaped by learning [13, 14]. In literature, three processes are indicated to modify innate taste preference: repeated experience of tasting food products, creation of associations with physiological consequences of food products with their taste, and social influences [11, 14, 15]. Taking these processes together, repeatedly offering food products to children in a positive context increases taste acceptance [14, 16]. Especially people in their close environment, such as parents, teachers and friends, play an important role in the development of children's taste acceptance [14, 17]. In school settings, teachers have the opportunity to expose children to food and teach them about how to make healthy food choices. Also, they can create a social norm in which tasting unfamiliar foods is normal.

Although taste acceptance has shown to be important in the promotion of healthy eating patterns among children, only few school-based interventions have been developed that focus on taste acceptance. The French programme 'Classes du Goût', known as the SAPERE method, consists of twelve lessons for 8-10 year old children and aims at encouraging children to taste unfamiliar foods. An evaluation of this programme showed a significant reduction of food neophobia and an increase in willingness to taste unfamiliar foods [18]. Besides, a 'SNAP-Ed' intervention from the US consists of four lessons for 8-9 year old children, including food tasting and assignments. An evaluation of these lessons found a significant increase in preference, knowledge, attitude and self-efficacy towards eating vegetables [19]. In the Netherlands, the nutrition education programme Taste Lessons was developed for primary schools to improve children's taste acceptance. It includes lessons on taste, healthy eating behaviour and food quality. Although 33% of the primary schools in The Netherlands have implemented Taste Lessons, the programme's effect has not

yet been evaluated. This study investigates the effect of children's exposure to Taste Lessons during a single school-year on psychosocial determinants towards the target behaviours tasting unfamiliar foods and eating healthily and a variety of foods.

Methods

Intervention design

Taste Lessons (Smaaklessen) is a national school-based nutrition education programme, developed by the Netherlands Nutrition Centre and Wageningen University for grades 1-8 of primary schools [20]. When a school registers for Taste Lessons, teachers are invited to attend an introductory workshop. In this workshop, the aim of the programme and the way it can be implemented at school are discussed. At the end of the workshop, the school receives a toolkit with teacher manuals and materials. The programme consists of 10-12 lessons discussing various topics in relation to three themes: 'taste', 'nutrition and health', and 'food quality'. Each lesson consists of 3-9 activities including experiments, cooking and tasting. Some lessons include home assignments which children are to complete with their parents. For each lesson, also tips for extra activities are provided, such as visiting a farmer. Teachers can implement Taste Lessons in a flexible way. They can, for instance, spread the lessons over a couple of weeks or cluster them in a project week. On average, the teachers implemented a third of the Taste Lessons programme.

Study design and procedure

A quasi-experimental design was used to assess the effect of Taste Lessons. The study was carried out among 1183 children of 49 classes in grades 5-8 in 21 primary schools. At the start of the 2011-2012 school year (September to December 2011), research assistants visited both intervention and control schools to collect baseline information. The children were requested to complete a questionnaire in the classroom with supervision of a research assistant.

During the school year, teachers in the intervention group were asked to notify the research team when they planned to teach their last lesson of Taste Lessons. Four weeks and six months after the teachers taught this lesson (February-June and September-December 2012), two consecutive follow-up measurements were conducted. During these measurements, schools were visited by the research team to let the children complete the same questionnaire as at baseline. Because of busy schedules and separated classes, five schools (three intervention and two control schools) received the questionnaires for the second

follow-up measurement by post and let the children fill out the questionnaire without guidance of a research assistant.

Schools in the control group were matched with schools in the intervention group based on grade, month of baseline measurement and province. Subsequently, the first and second follow-up measurement in the control group took place in the same period as the matched schools in the intervention group. The effect of Taste Lessons was measured by comparing changes in psychosocial determinants (follow-up minus baseline) between the intervention group and the control group.

Study population

Primary schools in the centre of the Netherlands that had registered for Taste Lessons and had followed an introductory workshop were invited to join the intervention group. Schools were included when they planned to teach Taste Lessons in grades 5-8, were not previously enrolled in Taste Lessons, and were not planning to participate in any other nutrition related programme. Twelve out of 37 schools met the inclusion criteria and were willing to participate (32%) (Figure 1). From these schools, 25 classes participated. To recruit schools for the control group, a list was consulted with all primary schools in the Netherlands. From this list, schools in the centre of the Netherlands and schools not registered for Taste Lessons were randomly approached to participate in the study. The schools were eligible to participate when they were not enrolled in any other nutrition-related programme outside of their regular school curriculum. Nine (24 classes) out of 68 schools were willing to participate (13%).

All recruited schools and classes participated in the baseline measurement. After the baseline measurement, four classes of different schools decided not to provide Taste Lessons that school-year. This reduced the intervention group for the first follow-up measurement to 21 classes in 12 schools (84% of the baseline group). All 24 classes in the control group participated in the first follow-up measurement.

Since the second follow-up measurement took place in the next school year, most classes had new teachers who had to be recruited for participation in the study. One teacher in the control group was not willing to participate. Furthermore, children in grade 8 started the next school-year in the first grade of secondary school and were excluded for the second follow-up measurement due to practical reasons. This resulted in a study population of 19 classes in 12 schools upon the second follow-up measurement in the intervention group (76% of the baseline group). The study population of the control group consisted of 17 classes in 8 schools (71% of the baseline group).

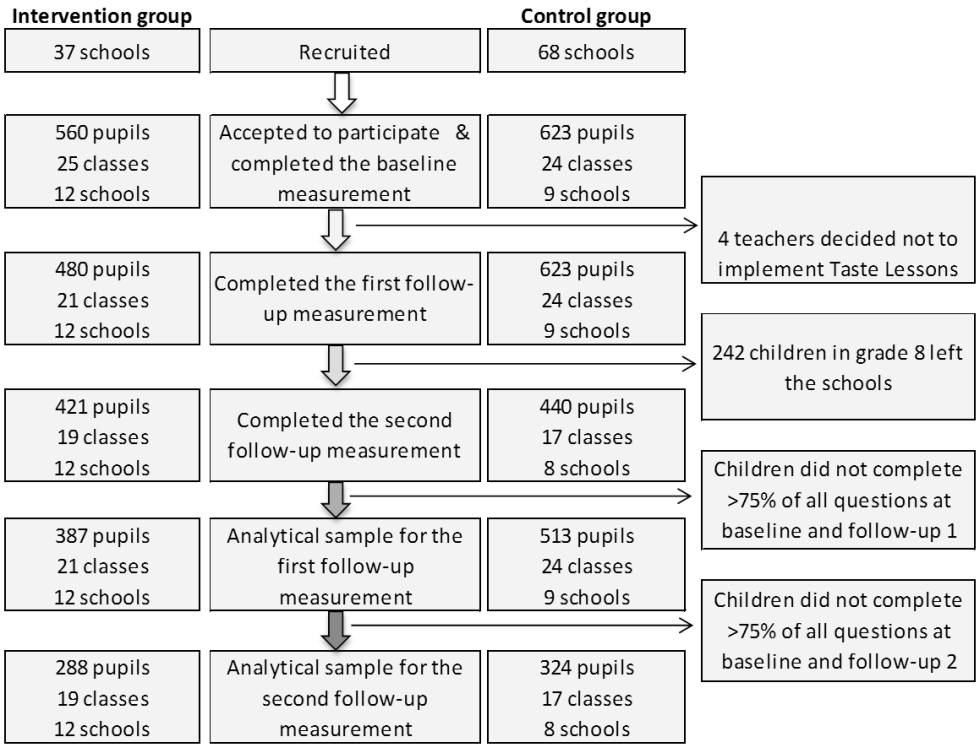

Figure 1. Flowchart of participants during the measurements and analyses.

Measures

Psychosocial determinants

Changes in psychosocial determinants towards the two target behaviours (namely, tasting unfamiliar foods and eating healthily and a variety of foods) were selected as outcome measures. Based on 'the integrative model of behavioural prediction' by Fishbein et al. [21], four determinants were selected: skills, attitude, subjective norm, and intention. Since Taste Lessons aims to change children's eating behaviour in a positive and playful way, attitude was divided in rational (attitude) and emotional (emotion) thoughts and feelings. Furthermore, knowledge and awareness were selected as relevant determinants. Children's knowledge was assessed by questions based on what they were taught during Taste Lessons. Awareness was measured by questions on how often children perform behaviours related to the target behaviours (scale from 1='never' to 5='always'). From the Taste Lessons materials, four skills were selected which are related to the target behaviours. In the questionnaires, the children were asked if they were able to perform the particular skill ('no', 'a little', 'yes'). Questions and scales for attitude and emotion ('how much do you think the

target behaviours are clever/interesting and nice/cool/tasty'), subjective norm ('how much do you think your classmates/ parents/teacher wants you to perform the target behaviours') and intention ('how much are you planning to perform the target behaviours') were used as described by Fishbein et al. [22], and were formulated in a way that is simple and understandable for children (scale from 1= 'no, not at all' to 5='yes, totally'). In addition, four determinants were selected to assess effect on taste acceptance for sixteen selected foods: number of foods known ('yes', 'no'), number of foods tasted (yes, no), expected positive taste of foods ('yes', 'a little', 'no'), and willingness to taste unfamiliar foods ('yes', 'maybe', 'no'). A questionnaire was developed to be filled out by the children themselves. Since the lessons for grades 5-6 differ from the lessons for grades 7-8, questionnaires were developed for both age-categories with overlapping and programme-specific questions (Table 1).

The questionnaires were pretested for clarity and length in grades 5-8 of a primary school and appeared appropriate after small adaptations. With data of the baseline measurement, the sets of questions per determinant were analysed on their internal consistency using Cronbach's α. All sets of questions scored a Cronbach's α >0.6. We concluded, therefore, that the concepts were assessed adequately. In the data analyses, we used mean score of the answers on these questions. Since single unrelated questions were asked to test different aspects of knowledge, Cronbach's α was not appropriate. Therefore, a score of correct answers was used in further analyses. Item facility and item discrimination were used as measures of quality. This resulted in the exclusion of questions which either were answered correctly by more than 80% of the children or poorly correlated to the total score on knowledge (Pearson's correlation <0.2) [23].

Sociodemographic factors

Children's questionnaires included questions on age (in years), sex, and ethnicity of the child and parents (country of birth). Children were classified as non-native when they or one of their parents were born outside the Netherlands. Information on the characteristics of the schools was obtained from the online database of Dutch primary schools [24]. The database included location (city, small city or town), religious principle (public or religious) and size of the school (small (<150 pupils), medium (150-400 pupils) or large (>400 pupils)). Socioeconomic status (SES) score was looked up in another online database [25]. This score was based on degree of education, income and work status of households within zip code districts, ranging from <0 as relatively high social status to >0 as relatively low social status in the district. These socio-demographic factors were considered as potential confounders in further analyses.

Table 1. Content of the questionnaires.

Determinant	Number of questions[1]			Cron-bachs α	Content of the questions	Answer scale
	5-6	7-8	overlap	overlap		
Determinants of taste acceptance						
Number of foods known	16	16	16	0.8	Do you know this product?	yes - no
Expected positive taste	16	16	16	0.8	Do you think the product tastes nice?	yes - a little - no
Number of foods tasted	16	16	16	0.8	Have you ever tasted this product?	yes - no
Willingness to taste unfamiliar foods	16	16	16	0.8	Would you taste this product (again)?	yes - maybe- no
Determinants of the target behaviours						
Knowledge	7	8	6	-	Statements about tasting and healthy eating	true - false
Awareness	8	9	7	0.6	I pay attention to 'aspects of tasting and healthy eating'	never(1) - always (5)
Skills	4	5	4	0.6	I'm able to 'recognise tastes and prepare healthy meals'	yes - a little - no
Attitude	8	8	8	0.8	I think 'target behaviour' is interesting, clever	disagree(1) - agree(5)
Emotion	10	10	10	0.8	I think 'target behaviour' is nice, cool, tasty	disagree(1) - agree(5)
Subjective norm - classmates	4	4	4	0.8	My classmates want me to 'target behaviour'	disagree(1) - agree(5)
Subjective norm - parents	4	4	4	0.7	My parents want me to 'target behaviour'	disagree(1) - agree(5)
Subjective norm - teachers	4	4	4	0.9	My teacher wants me to 'target behaviour'	disagree(1) - agree(5)
Intension	4	4	4	0.6	I have plans to perform 'tagret behaviour'	disagree(1) - agree(5)

[1] Number of questions in the questionnaire for grades 5-6, grades 7-8 and both questionnaires.

Statistical analysis

SPSS (version 19.0) was used for descriptive analyses. First, the intervention group and control group were compared on their socio-demographic characteristics by use of one-way ANOVA. Second, mean scores on the determinants were calculated for children who filled out at least 75% of the questions in all determinants. Third, change scores were calculated. These consisted of difference in mean score between the baseline measurement and follow-up measurements [26]. In the main analyses, data of groups 5-8 were pooled, including overlapping questions. Stratified analyses were conducted for grades 5-6 and 7-8 separately, including the group-specific questions and specified analyses were conducted for each of the two target behaviours.

Multilevel analyses were performed by use of the programme HLM (version 7) to evaluate the effect of Taste Lessons on change in psychosocial determinants, including three levels: (1) pupil, (2) class and (3) school. First, simple linear regression was used, with change scores of each psychosocial determinant as the dependent variable and intervention as explanatory variable. Second, potential confounders and effect modifiers were identified by adding all socio-demographic factors to the model one by one. From these analyses, children's age and sex appeared to be significant confounders for most psychosocial determinants, whereas no effect modifiers were found. Third, multivariate linear regression analyses were performed, adjusting for children's age and sex.

With the results of the adjusted analyses, relative effect sizes were calculated for each determinant. These were expressed as Cohen's *d* [27]: the β of intervention (adjusted difference in change score between the intervention and control group) divided by the total standard deviation over all levels of the adjusted model. A Cohen's *d* of 0.2 is interpreted as small, 0.5 as medium, and 0.8 as a large effect size [27]. Results were interpreted as significant when $p<0.05$ (two sided).

Results

Characteristics of the study population

The intervention group included relatively younger children, more boys, and more non-native children compared to the control group (Table 2). Furthermore, the intervention group included more schools in cities, more schools with a religious principle, more small schools, and more schools in lower SES districts than the control group did.

Table 2. Socio-demographic characteristics of the children and schools in the intervention and control group.

Determinant	Intervention group (N=387)		Control group (N=513)	
	N	% or mean (SD)	N	% or mean (SD)
Children				
Age (in years)	387	9.6 (1.3)	513	9.9 (1.2)
Sex				
- Boy	211	55	243	47
- Girl	176	45	270	53
Ethnicity [1]				
- Native	244	68	413	81
- Non-native	115	32	96	19
Schools				
Location				
- City	82	21	63	12
- Small city	177	46	178	35
- Town	128	33	272	53
Religious principle				
- Public	114	30	376	73
- Religious	273	70	137	27
School size				
- Small	129	33	123	24
- Medium	258	67	217	42
- Large	0	0	173	34
Status score (SES) on zip code [2]	387	-0.1 (0.6)	513	-0.4 (0.5)

[1] A child is labelled as non-native when s/he or at least one parent is born outside the Netherlands. For 28 children in the intervention group and 4 children in the control group information is missing on ethnicity.

[2] Status score based on the zip code of the school. Mean status score for the Netherlands is 0; values >0 indicate a neighbourhood with more social deprivation.

Effects on taste acceptance

Both the intervention and the control group showed a positive change on the determinants related to taste acceptance at both the first and second follow-up measurement (Table 3). The intervention group showed a significantly higher positive change in foods known and foods tasted than the control group. These effects, however, did not remain significant at the second follow-up measurement.

Effects on the psychosocial determinants

Both groups showed a positive change in most psychosocial determinants between the baseline and both follow-up measurements (Table 3). At the first follow-up measurement, the intervention group showed a significantly higher positive change in knowledge than the control group. This effect remained significant at the second follow-up measurement. Furthermore, at the first follow-up measurement the intervention group showed a significantly higher change in subjective norm of the teacher and intention, and a borderline significantly higher change in awareness than the control group. At the second follow-up measurement, the intervention group showed a borderline significantly higher negative change in emotion compared to the control group.

Stratified analyses for grades 5-6 and grades 7-8

Overall, results of stratified analyses for grades 5-6 and 7-8 showed similar results as the main analyses (Table 4). In grades 5-6, however, no (borderline) significant effect of Taste Lessons was found on number of foods known and intention, but a significantly higher positive change in subjective norm of the parents was found at the first follow-up measurement. Regarding to grades 7-8, no (borderline) effects of Taste Lessons were found on number of foods known and subjective norm of the teacher. On the other hand, a borderline significantly higher positive change in attitude was found at the first follow-up measurement.

Specified analyses for the two target behaviours

Overall, results of specified analyses for the target behaviours showed significant effects for both follow-up measurements for determinants similar to those in the main analyses (Table 5). However, some differences appeared between the target behaviours. Subjective norm of the teacher was only significant for tasting unfamiliar foods, whereas intention was only significant for eating healthily and a variety of foods. The negative effect on emotion at the second follow-up measurement showed in the main analyses to be the strongest for eating healthily and a variety of foods.

Table 3. Mean scores, change scores and effect sizes for each determinant for grades 5-8 together[1].

	Mean score			Mean change score		Effect size	
	Baseline Mean (SD)	Follow-up 1 Mean (SD)	Follow-up 2 Mean (SD)	Follow-up 1 Mean (SD)	Follow-up 2 Mean (SD)	Follow-up 1 Cohen's *d* (95% CI)	Follow-up 2 Cohen's *d* (95% CI)
Determinants of taste acceptance							
Number of foods known							
Intervention group	0.7 (0.2)	0.8 (0.2)	0.9 (0.1)	0.1 (0.2)	0.2 (0.2)	0.2 (0.0 - 0.4)*	0.1 (-0.1 - 0.4)
Control group	0.7 (0.2)	0.8 (0.2)	0.9 (0.1)	0.1 (0.1)	0.2 (0.2)		
Expected positive taste							
Intervention group	1.1 (0.3)	1.2 (0.4)	1.3 (0.3)	0.1 (0.3)	0.1 (0.3)	0.01(-0.1 - 0.2)	-0.0 (-0.2 - 0.2)
Control group	1.2 (0.4)	1.2 (0.3)	1.3 (0.3)	0.1 (0.3)	0.1 (0.3)		
Number of foods tasted							
Intervention group	0.5 (0.2)	0.6 (0.2)	0.6 (0.2)	0.1 (0.2)	0.2 (0.2)	0.2 (0.1 - 0.4)*	0.1 (0.0 - 0.3)
Control group	0.5 (0.2)	0.6 (0.2)	0.6 (0.2)	0.1 (0.2)	0.1 (0.2)		
Willingness to taste unfamiliar foods							
Intervention group	1.2 (0.4)	1.3 (0.4)	1.3 (0.4)	0.1 (0.3)	0.1 (0.4)	0.1 (-0.1 - 0.2)	-0.1 (-0.2 - 0.1)
Control group	1.3 (0.4)	1.3 (0.4)	1.4 (0.4)	0.1 (0.3)	0.2 (0.4)		
Determinants of the target behaviours							
Knowledge							
Intervention group	0.6 (0.2)	0.8 (0.2)	0.8 (0.2)	0.1 (0.3)	0.2 (0.2)	0.3 (0.1 - 0.4)**	0.2 (0.1 - 0.4)*
Control group	0.7 (0.2)	0.8 (0.2)	0.8 (0.2)	0.1 (0.2)	0.1 (0.2)		
Awareness							
Intervention group	3.0 (0.7)	3.2 (0.8)	3.1 (0.7)	0.2 (0.7)	0.0 (0.9)	0.1 (0.0 - 0.3)	-0.1 (-0.3 - 0.1)
Control group	3.1 (0.7)	3.1 (0.7)	3.1 (0.8)	0.0 (0.7)	0.1 (0.8)		

Table 3. (Continued)

	Mean score			Mean change score		Effect size	
	Baseline	Follow-up 1	Follow-up 2	Follow-up 1	Follow-up 2	Follow-up 1	Follow-up 2
	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)	Cohen's *d* (95% CI)	Cohen's *d* (95% CI)
Skills							
Intervention group	1.6 (0.4)	1.7 (0.3)	1.6 (0.4)	0.1 (0.5)	0.1 (0.5)	0.1 (-0.1 - 0.2)	-0.1 (-0.3 - 0.1)
Control group	1.5 (0.4)	1.6 (0.5)	1.6 (0.4)	0.1 (0.5)	0.1 (0.5)		
Attitude							
Intervention group	3.7 (0.8)	3.7 (0.8)	3.6 (0.9)	0.1 (0.8)	-0.1 (1.0)	0.1 (-0.1 - 0.2)	-0.1 (-0.3 - 0.1)
Control group	3.6 (0.9)	3.6 (0.9)	3.6 (0.9)	0.0 (0.9)	0.1 (1.0)		
Emotion							
Intervention group	3.0 (0.8)	3.0 (0.9)	2.8 (0.9)	0.0 (0.8)	-0.3 (0.9)	0.0 (-0.1 - 0.1)	-0.2 (-0.4 - 0.0)
Control group	2.8 (0.7)	2.8 (0.8)	2.8 (0.9)	0.0 (0.8)	0.0 (0.9)		
Subjective norm - classmates							
Intervention group	2.7 (1.0)	2.8 (1.0)	2.6 (1.1)	0.0 (1.0)	-0.2 (1.2)	0.1 (-0.1 - 0.2)	-0.1 (-0.2 - 0.1)
Control group	2.6 (0.9)	2.5 (1.0)	2.6 (1.0)	-0.1 (1.0)	-0.1 (1.1)		
Subjective norm - parents							
Intervention group	4.2 (0.8)	4.4 (0.7)	4.3 (0.8)	0.2 (0.6)	0.1 (0.8)	0.1 (-0.1 - 0.2)	0.0 (-0.2 - 0.1)
Control group	4.3 (0.7)	4.4 (0.7)	4.4 (0.7)	0.1 (0.7)	0.1 (0.8)		
Subjective norm – teachers							
Intervention group	3.2 (1.0)	3.5 (1.1)	3.3 (1.1)	0.4 (1.1)	0.2 (1.2)	0.2 (0.0 - 0.3)*	0.0 (-0.1 - 0.2)
Control group	2.9 (1.1)	3.1 (1.1)	3.1 (1.2)	0.1 (1.2)	0.2 (1.2)		
Intention							
Intervention group	3.8 (0.7)	3.9 (0.8)	3.9 (0.8)	0.1 (0.8)	0.1 (0.9)	0.2 (0.0 - 0.3)*	-0.1 (-0.2 - 0.1)
Control group	3.8 (0.7)	3.9 (0.8)	4.0 (0.8)	0.0 (0.8)	0.1 (0.7)		

[1] Mean scores and change scores are unadjusted, but effect sizes are adjusted for children age and sex. N=900 at the first follow-up measurement (grades 5-8) and N=592 at the second follow-up measurement. (grades 5-7) * p<0.05, ** p<0.01, *** p<0.001

Table 4. Effect sizes for each determinant, stratified into grade 5-6 and 7-8[1].

	Grades 5-6		Grades 7-8	
	Follow-up 1 Cohen's *d* (95% CI)	Follow-up 2 Cohen's *d* (95% CI)	Follow-up 1 Cohen's *d* (95% CI)	Follow-up 2 Cohen's *d* (95% CI)
Determinants of taste acceptance				
Number of foods known	0.2 (0.0 - 0.5)	0.2 (0.0 - 0.5)	0.2 (-0.1 - 0.4)	0.1 (-0.2 - 0.4)
Expected positive taste	0.1 (-0.1 - 0.3)	0.0 (-0.2 - 0.2)	0.1 (-0.1 - 0.3)	0.1 (-0.2 - 0.4)
Number of foods tasted	0.3 (0.0 - 0.5)*	0.2 (0.0 - 0.4)	0.2 (0.0 - 0.4)	0.3 (0.0 - 0.6)
Willingness to taste unfamiliar foods	0.2 (0.0 - 0.3)	0.1 (-0.1 - 0.3)	0.0 (-0.2 - 0.2)	-0.2 (-0.5 - 0.1)
Determinants of the target behaviours				
Knowledge	0.3 (0.0 - 0.5)	0.2 (0.0 - 0.4)	0.2 (0.0 - 0.4)	0.1 (-0.2 - 0.4)
Awareness	0.2 (0.0 - 0.4)	0.1 (-0.2 - 0.3)	-0.1 (-0.3 - 0.2)	-0.3 (-0.7 - 0.0)
Skills	0.1 (-0.1 - 0.3)	-0.1 (-0.3 - 0.1)	0.1 (-0.1 - 0.4)	0.0 (-0.3 - 0.3)
Attitude	0.0 (-0.2 - 0.2)	-0.1 (-0.3 - 0.1)	0.2 (0.0 - 0.4)	-0.1 (-0.5 - 0.2)
Emotion	0.0 (-0.2 - 0.2)	-0.2 (-0.4 - 0.1)	0.0 (-0.2 - 0.2)	-0.3 (-0.6 - 0.1)
Subjective norm - classmates	0.1 (-0.1 - 0.3)	0.0 (-0.2 - 0.2)	0.2 (0.0 - 0.4)	-0.1 (-0.4 - 0.2)
Subjective norm - parents	0.3 (0.1 - 0.5)*	0.1 (-0.1 - 0.3)	0.0 (-0.3 - 0.3)	-0.3 (-0.6 - 0.0)
Subjective norm - teachers	0.2 (0.0 - 0.4)	0.1 (-0.1 - 0.3)	0.2 (0.0 - 0.3)	-0.1 (-0.3 - 0.2)
Intention	0.2 (0.0 - 0.4)	0.0 (-0.2 - 0.2)	0.2 (0.0 - 0.4)*	-0.1 (-0.4 - 0.2)

[1] Effect sizes are adjusted for children age and sex. For grades 5-6: N=407 at the first follow-up measurement and N=408 at the second follow-up measurement. For grades 7(-8): N=474 at the first effect measurement and N=195 at the second effect measurement. * p<0.05, ** p<0.01, *** p<0.001

Table 5. Effect sizes for each determinant per target behaviour[1].

	Tasting unfamiliar foods		Eating healthily and varied	
	Follow-up 1 Cohen's *d* (95% CI)	Follow-up 2 Cohen's *d* (95% CI)	Follow-up 1 Cohen's *d* (95% CI)	Follow-up 2 Cohen's *d* (95% CI)
Determinants of the target behaviours				
Knowledge	0.2 (0.0 - 0.3)*	0.2 (0.0 - 0.4)	0.2 (0.1 - 0.4)*	0.2 (0.0 - 0.4)*
Awareness	0.1 (-0.1 - 0.2)	0.0 (-0.2 - 0.2)	0.2 (0.0 - 0.3)	-0.1 (-0.3 - 0.1)
Skills	0.1 (0.0 - 0.3)	0.0 (-0.2 - 0.2)	0.1 (-0.1 - 0.2)	-0.1 (-0.3 - 0.1)
Attitude	0.1 (-0.1 - 0.2)	-0.2 (-0.3 - 0.0)	0.0 (-0.1 - 0.2)	0.0 (-0.3 - 0.1)
Emotion	0.0 (-0.1 - 0.2)	-0.2 (-0.4 - 0.0)	0.0 (-0.2 - 0.1)	-0.2 (-0.4 - 0.0)*
Subjective norm - classmates	0.1 (0.0 - 0.3)	-0.2 (-0.4 - 0.1)	0.0 (-0.1 - 0.2)	-0.1 (-0.3 - 0.1)
Subjective norm - parents	0.2 (0.0 - 0.3)	0.0 (-0.2 - 0.2)	0.0 (-0.2 - 0.1)	0.0 (-0.2 - 0.2)
Subjective norm - teachers	0.2 (0.0 - 0.3)*	0.0 (-0.2 - 0.2)	0.1 (-0.1 - 0.2)	0.0 (-0.2 - 0.2)
Intention	0.1 (-0.1 - 0.2)	-0.1 (-0.3 - 0.1)	0.3 (0.1 - 0.4)**	0.2 (0.0 - 0.4)

[1] Effect sizes are adjusted for children age and sex. N=710 at the first follow-up measurement and N=484 at the second follow-up measurement.
* p<0.05, ** p<0.01, *** p<0.001

Discussion

The results of this study show that Taste Lessons in grades 5-8 of the primary school increased children's knowledge towards tasting unfamiliar foods and eating healthily and a variety of foods. This higher increase in knowledge remained significant six months after the intervention. The number of known foods also showed a significantly higher increase after receiving Taste Lessons.

Furthermore, four weeks after the implementation of, on average, a third of the Taste Lessons programme, a positive effect on the number of foods tasted by children was observed. Other short-term effects were found on children's subjective norm of their teacher and parents to taste unfamiliar foods (in grades 5-6), and their intention to eat healthily and a variety of foods (in grades 7-8). Finally, Taste Lessons appeared to be inversely associated with children's enjoyment of eating healthily and a variety of foods on the long term (in grades 7-8).

Reflection on used methods

In this quasi-experimental study, different methods were used to recruit schools for the intervention and control group. In the intervention group, schools were included that registered for Taste Lessons and participated in the introductory workshop. The control group consisted of a selection of primary schools located in a similar area as the intervention schools. These schools were approached for participation by the research team. When comparing the characteristics of both groups with those of all Dutch primary schools, schools in the intervention group appeared representative, whereas the control schools differed in socio-demographic characteristics. These differences may have influenced the change in psychosocial determinants. However, only children's age and sex were found to be significant predictors of change and after controlling for these confounders, effects of Taste Lessons remained significant. Furthermore, as both groups had mean baseline values at the middle of the scale, a ceiling effect is unlikely to have influenced the results.

For this study, questionnaires were developed to be filled out by children themselves. These self-reports may have caused socially desirable answers and measurements errors. For example, children's cognitive capabilities may have been too limited to sufficiently understand the questions and to provide appropriate answers. With the development of the questionnaire, however, attention was paid to children's cognitive limitations to reduce measurement errors. Questions and answer scales were developed and piloted. Furthermore, children completed the questionnaire under supervision of a research assistant, who also instructed the children on how to fill out the questionnaire properly

and who was available for questions. As a result, the reliability of questionnaires appeared to be sufficient with Cronbach's α >0.6.

Children needed on average 30 minutes to complete the questionnaire. Although this length appeared to be acceptable at the pretest of the questionnaire, some children were not able to finish the questionnaire in time, especially children with reading problems. Consequently, the number of unanswered questions on the last pages was higher compared to the number of unanswered questions on the first pages. Since no difference was found in the number of unanswered questions between the intervention and control group, this issue is unlikely to have influenced our results. On the other hand, it has resulted in reduced power of the study, as children's data were only included in the analyses when at least 75% of all determinants in the questionnaire had been filled out.

Children in grade 8 were not able to participate in the second follow-up measurement. Since this measurement took place in the next school year, these children had left primary school. The loss of children in grade 8 for the second follow-up measurement might have caused insufficient power to detect long term effects.

Teachers in the intervention group were free to either implement Taste Lessons in a project week or to spread the lessons over a wider period of time. Consequently, the period between baseline and follow-up measurements differed between the intervention schools. However, teachers were asked to notify the researchers when they planned to teach their last Taste Lesson. Follow-up measurements were taken twice in each intervention school. The first measurement was approximately four weeks after the last Taste Lesson, and the second approximately six months after the last Taste Lesson. Besides, the measurement periods for the intervention and control schools were equal due to matching of schools. These efforts may have reduced potential time-effects.

Reflection on the results

Tasting different foods is an essential step in food acceptance [16, 18] and, with that, reaching a healthy and varied eating pattern [15, 16]. Therefore, an important aim of Taste Lessons is encouraging children to taste unfamiliar foods. This study showed that children in the intervention group tasted more different foods than children in the control group, which suggests that Taste Lessons contributes to children's taste acceptance. The intervention group, however, did not show a significantly higher increase in willingness to taste unfamiliar foods than the control group. An evaluation of a French study on twelve taste lessons ('Classes du Goût', SAPERE method) showed that children's preferences of the foods they were exposed to in the programme was significantly higher in the intervention group than in the control group. This was the case both directly after the lessons

had taken place and ten months after the intervention [28]. Another evaluation of the same programme showed significant short-term effects on reduction of food neophobia. This outcome is related to willingness to taste unfamiliar foods [18]. The stronger results of these studies might be explained by the higher number of implemented lessons in those studies.

This study showed a significant increase in children's knowledge on the longer term. This effect was consistently found in all grades, for both target behaviours and also for the number of known foods. Besides, this study found a borderline significant short-term effect on children's awareness of eating healthily and a variety of foods, which is closely related to knowledge. Most other evaluation studies on school-based nutrition programmes found effect on knowledge on the short and the longer term as well, such as 'High 5' [29], 'CATCH' [30, 31], 'Be Smart' [32] and 'Pathways' [33]. No comparisons could be made regarding awareness, since to our knowledge no other evaluation studies included awareness as outcome measure.

Although Taste Lessons include many practical assignments, we did not find an effect on skills. Possibly, the type of skills assessed in our questionnaire requires higher exposure to the programme than achieved in this study. Other evaluation studies of school-based nutrition programmes such as 'High 5' and 'CATCH' found effect on children's self-efficacy, which is closely related to skills [19, 29, 31, 34, 35]. The intensity of implemented lessons and activities of most of these programmes was higher than that of Taste Lessons. 'High 5', for example, consists of twelve lessons solely focussing on fruit and vegetables. In 'CATCH', a more integral approach was used.

With regard to attitude, we found a borderline significant short-term effect in grades 7-8. Other evaluation studies found a positive effect on attitude on the short or longer term [19, 31, 36, 37]. In a review of Contento et al. [38], it is stated that effects of school-based nutrition education programmes on attitudes were generally positive but inconsistent. Furthermore, it states that up to 50 classroom hours of exposure are required to achieve stable improvements (38). The implementation of 3-4 lessons of Taste Lessons might explain the weak and inconsistent effects on attitude we found in our study.

In our study, we did not find any effect of Taste Lessons on children's emotion. In contrast, at the second follow-up measurement, the intervention group showed a higher decrease on enjoyment of eating healthily and a variety of foods than the control group. At baseline, children in the intervention group showed a significantly higher score on emotion compared to the control group. This difference remained significant one month after the intervention. Six months after the intervention, however, the higher score in the intervention group dropped to a score similar to that of the control group at all three moments of measuring.

A possible explanation for this decrease in emotion in the intervention group at the second follow-up measurement, might be that a habituation process took place [39], or the absence of new stimuli to maintain positive feelings towards the behaviour. Positive feelings about a certain behaviour might fade to neutral feelings over time. Since no other evaluation studies assessed effect on emotion, more research needs to be conducted for exploring the role of emotion in changing children's eating behaviour.

In this study we found short-term effects of Taste Lessons on children's subjective norm of the teacher and parents to taste unfamiliar foods. Similar results were found in the evaluation study of 'High 5'. In this study, a significantly higher increase in the children's perceived social norm of the teacher towards eating fruit and vegetables one year after baseline was found in the intervention group compared to the control group [29]. There was also a significantly higher increase in the children's perceived social norm of the family two years after baseline, compared to the control group. To our knowledge, other evaluation studies of school-based nutrition programmes did not assess subjective norm of classmates, teachers and parents. Social influence is, however, identified as an important factor in the development of children's food preferences and eating behaviour [11, 15, 40]. The observed effect on children's subjective norm of their teacher establishes that children feel pressure to perform the desired behaviours focussed on in class.

Implications for (sustained) behavioural change

As this study shows positive effects of Taste Lessons on psychosocial determinants, such as knowledge, subjective norm and intention, the programme might contribute to behavioural change on the longer term. A review of European school-based nutrition intervention programmes revealed that 76% of the programmes were able to show improvements on children's eating pattern, with a duration varying from two weeks to five years. Even stronger effects were found among multicomponent interventions [41]. However, the results of our study showed that only effect on knowledge remained significant in the new school year. Short-term effects on other determinants did not sustain over a longer period of time. The limited number of implemented lessons might explain these effects. Primary schools are not obliged to implement nutrition education in the Netherlands; this type of education is optional. A more intensive implementation of Taste Lessons in subsequent years, also in combination with other school activities and a strong support platform, might be required to achieve sustainable effects on psychosocial determinants. As they play a key role in the development of healthy eating behaviour of children, also parents should be involved in the programme to reach improved eating behaviours in the long term.

Conclusions

Results show that a partially implemented one-year 'Taste Lessons' programme demonstrates small but statistically significant short-term effects on increasing the number of foods known and tasted, and knowledge, subjective norm of the teacher and intention in relation to taste acceptance and healthy eating behaviour. Full and repeated implementation of Taste Lessons in subsequent years might result in larger effects.

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References

1. Bellisle F. Child nutrition and growth: butterfly effects? British Journal of Nutrition. 2008;99(SupplementS1):S40-S5.
2. Uauy R, Kain J, Mericq V, Rojas J, Corvalán C. Nutrition, child growth, and chronic disease prevention. Annals of Medicine. 2008;40(1):11-20.
3. Dehghan M, Akhtar-Danesh N, Merchant A. Childhood obesity, prevalence and prevention. Nutrition Journal. 2005;4(1):24.
4. Bammann K, Peplies J, Pigeot I, Ahrens W. IDEFICS: a multicenter European project on diet- and lifestyle-related disorders in children. Medizinische Klinik (Munich, Germany : 1983). 2007;102(3):230-5.
5. Drewnowski A, Henderson SA, Driscoll A, Rolls BJ. The Dietary Variety Score: assessing diet quality in healthy young and older adults. J Am Diet Assoc. 1997;97(3):266-71.
6. Falciglia GA, Horner SL, Liang J, Couch SC, Levin LS. Assessing dietary variety in children: development and validation of a predictive equation. J Am Diet Assoc. 2009;109(4):641-7.
7. Tucker KL. Eat a variety of healthful foods: old advice with new support. Nutr Rev. 2001;59(5):156-8.
8. Nicklas TA, Baranowski T, Cullen KW, Berenson G. Eating Patterns, Dietary Quality and Obesity. Journal of the American College of Nutrition. 2001;20:599 - 608.
9. Kant AK, Schatzkin A, Harris TB, Ziegler RG, Block G. Dietary diversity and subsequent mortality in the First National Health and Nutrition Examination Survey Epidemiologic Follow-up Study. Am J Clin Nutr. 1993;57(3):434-40.
10. Birch LL. Development of food acceptance patterns in the first years of life. The Proceedings of the Nutrition Society. 1998;57(4):617-24.
11. Birch LL. Developmental aspects of eating. In: Sepherd R, editor. Handbook of Psychophysiology of Human Eating. Chichester: Wiley; 1989. p. 179-203.
12. Birch LL. Development of food preferences. Annual review of nutrition. 1999;19:41-62.
13. Birch LL, Fisher JO. Development of eating behaviors among children and adolescents. Pediatrics. 1998;101(3 Pt 2):539-49.
14. Westenhoefer J. Establishing good dietary habits -- capturing the minds of children. Public Health Nutr. 2001;4(1A):125-9.
15. Contento IR. Nutrition Education: Linking Research, Theory, and Practice.: Jones&Barlett Learning.; 2007.
16. Dovey TM, Staples PA, Gibson EL, Halford JCG. Food neophobia and 'picky/fussy' eating in children: A review. Appetite. 2008;50(2–3):181-93.
17. Rozin P. The role of learning in the acquisition of food preferences by humans. In: Shepherd R, editor. Handbook of the Psychophysiology of Human Eating. Chichester: Wiley; 1989. p. 205-27.
18. Reverdy C, Chesnel F, Schlich P, Köster EP, Lange C. Effect of sensory education on willingness to taste novel food in children. Appetite. 2008;51(1):156-65.
19. Wall DE, Least C, Gromis J, Lohse B. Nutrition Education Intervention Improves Vegetable-Related Attitude, Self-Efficacy, Preference, and Knowledge of Fourth-Grade Students. Journal of School Health. 2012;82(1):37-43.
20. Smaaklessen: Steunpunt Smaaklessen&Schoolgruiten; [cited 2013 April]. Available from: www.smaaklessen.nl.
21. Fishbein M, Triandis HC, Kanfer FH, Becker M, Middlestadt SE. Factors influencing behavior and behavior change. In: A. Baum TRR, J.E. Singer, editor. Handbook of health psychology. Mahwah, NJ Erlbaum; 2001. p. 3-17.
22. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior: Englewood Cliffs, NJ: Prentice-Hall; 1980.
23. Parmenter K, Wardle J. Evaluation and Design of Nutrition Knowledge Measures. Journal of Nutrition Education. 2000;32(5):269-77.
24. Onderwijsdata - primair onderwijs: Dienst Uitvoering Onderwijs - Ministerie van Onderwijs, Cultuur en Wetenschap; [cited 2012 December]. Available from: www.duo.nl.
25. Statusscores: Sociaal en Cultureel Planbureau; [cited 2012 October]. Available from: www.scp.nl.

26. Van Breukelen GJP. ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. Journal of Clinical Epidemiology. 2006;59(9):920-5.
27. Cohen J. A power primer. Psychol Bull. 1992;112(1):155-9.
28. Reverdy C, Schlich P, Köster EP, Ginon E, Lange C. Effect of sensory education on food preferences in children. Food Quality and Preference. 2010;21(7):794-804.
29. Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, et al. Increasing the Fruit and Vegetable Consumption of Fourth-Graders: Results from the High 5 Project. Preventive Medicine. 2000;30(4):309-19.
30. Edmundson E, Parcel GS, Feldman HA, Elder J, Perry CL, Johnson CC, et al. The Effects of the Child and Adolescent Trial for Cardiovascular Health upon Psychosocial Determinants of Diet and Physical Activity Behavior. Preventive Medicine. 1996;25(4):442-54.
31. Auld GW, Romaniello C, Heimendinger J, Hambidge C, Hambidge M. Outcomes from a School-based Nutrition Education Program Using Resource Teachers and Cross-disciplinary Models. Journal of Nutrition Education. 1998;30(5):268-80.
32. Warren JM, Henry CJ, Lightowler HJ, Bradshaw SM, Perwaiz S. Evaluation of a pilot school programme aimed at the prevention of obesity in children. Health Promot Int. 2003;18(4):287-96.
33. Caballero B, Clay T, Davis SM, Ethelbah B, Rock BH, Lohman T, et al. Pathways: a school-based, randomized controlled trial for the prevention of obesity in American Indian schoolchildren. The American Journal of Clinical Nutrition. 2003;78(5):1030-8.
34. Belansky ES, Romaniello C, Morin C, Uyeki T, Sawyer RL, Scarbro S, et al. Adapting and Implementing a Long-Term Nutrition and Physical Activity Curriculum to a Rural, Low-Income, Biethnic Community. Journal of Nutrition Education and Behavior. 2006;38(2):106-13.
35. Keihner AJ, Meigs R, Sugerman S, Backman D, Garbolino T, Mitchell P. The Power Play! Campaign's School Idea & Resource Kits Improve Determinants of Fruit and Vegetable Intake and Physical Activity among Fourth- and Fifth-Grade Children. Journal of Nutrition Education and Behavior. 2011;43(4, Supplement 2):S122-S9.
36. Nicklas TA, Johnson CC, Myers L, Farris RP, Cunningham A. Outcomes of a High School Program to Increase Fruit and Vegetable Consumption: Gimme 5 - A Fresh Nutrition Concept for Students. Journal of School Health. 1998;68(6):248-53.
37. Joshi A, Azuma AM, Feenstra G. Do Farm-to-School Programs Make a Difference? Findings and Future Research Needs. Journal of Hunger & Environmental Nutrition. 2008;3(2-3):229-46.
38. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
39. Brickman P, Coates D, Janoff-Bulman R. Lottery winners and accident victims: is happiness relative? J Pers Soc Psychol. 1978;36(8):917-27.
40. Westenhoefer J. Establishing dietary habits during childhood for long-term weight control. Ann Nutr Metab. 2002;46 Suppl 1:18-23.
41. Van Cauwenberghe E, Maes L, Spittaels H, van Lenthe FJ, Brug J, Oppert JM, et al. Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. The British journal of nutrition. 2010;103(6):781-97.

2

Unravelling the effect of the Dutch school-based nutrition programme Taste Lessons: the role of dose, appreciation and interpersonal communication

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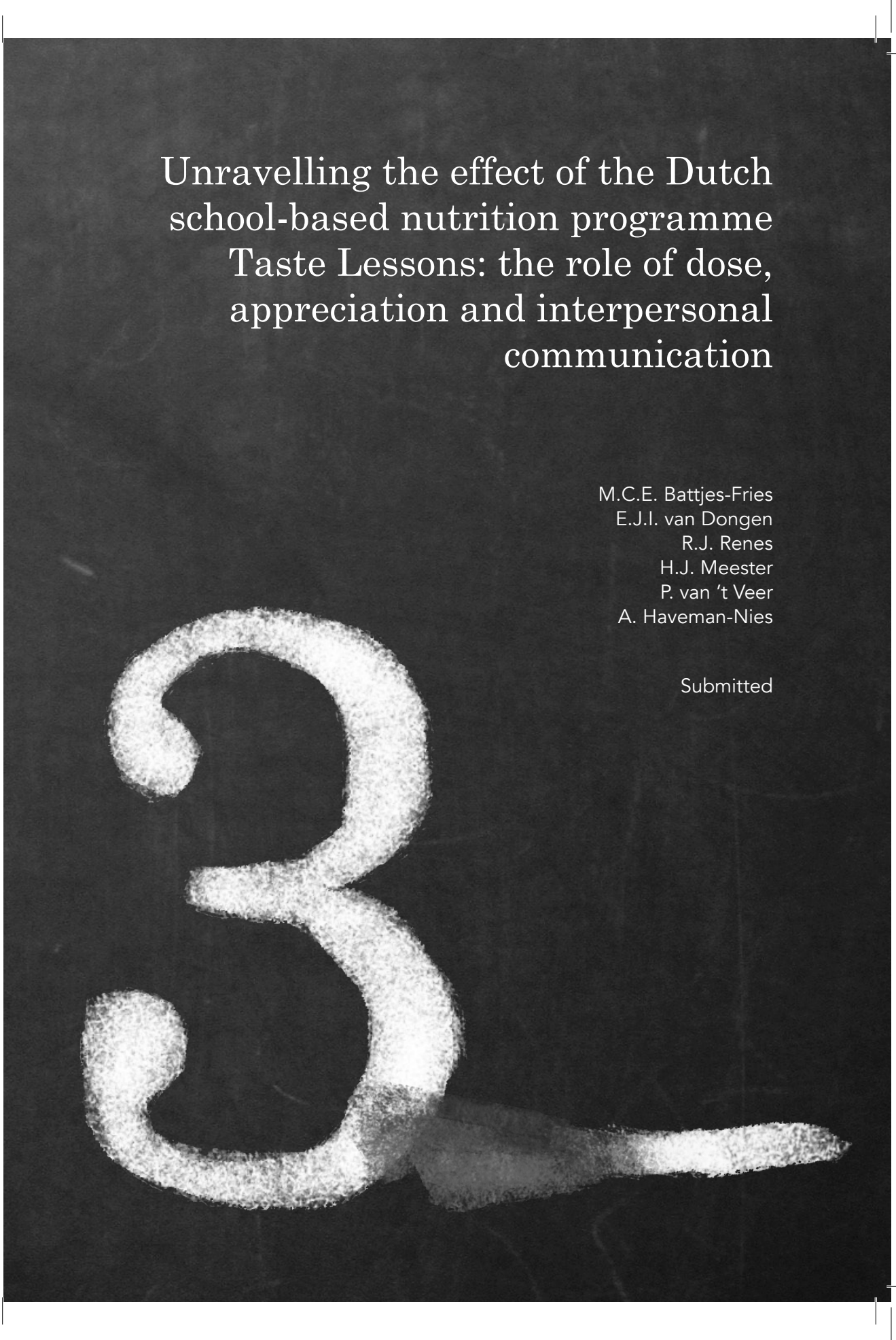

Abstract

Introduction

To unravel the effect of school-based nutrition education, insight into the implementation process is needed. In this study, process indicators of Taste Lessons (a nutrition education programme for Dutch primary schools) and their association with changes in psychosocial determinants relevant to healthy eating behaviour are studied.

Methods

The study sample consisted of 392 Dutch primary school children from 12 schools. Data were collected using teacher and child questionnaires at baseline, and at one and six months after the intervention. Multilevel regression analyses were conducted to study the association between dose, appreciation and interpersonal communication, and change in knowledge, awareness, skills, attitude, emotion, subjective norm and intention towards two target behaviours.

Results

With an average implementation of a third of the programme activities, dose positively predicted change in subjective norm of the teacher after one month. Teachers and children highly appreciated Taste Lessons. Whereas teacher appreciation was inversely associated, child appreciation was positively associated with change in awareness, emotion and subjective norm of teachers after one month and in attitude and subjective norm of parents after six months. Interpersonal communication was positively associated with change in five determinants after one month and in attitude and intention after six months.

Conclusions

The implementation process is related to the programme outcomes of Taste Lessons. Process data provide valuable insights into factors that contribute to the effect of interventions in real-life settings.

Introduction

School settings seem to be an effective environment for teaching children about healthy nutrition [1-3]. Therefore a wide variety of school-based nutrition interventions have been developed in the last few decades, showing varying results [1-3]. Few studies on nutrition education programmes have studied the influence of the implementation process on the intervention outcomes [4-9]. In evaluation settings where programme delivery is not controlled by researchers and thus will vary between different intervention sites, it is especially important to relate process indicators to effect outcomes in order to obtain insight into which factors influenced the obtained results [2, 9-14].

Delivered dose, acceptability (appreciation) and integrity (fidelity, quality of implementation) are perceived as the most important process indicators [11, 13 15]. In addition, teacher-related factors, adaptations to the programme and the quality of the process (such as attention and engagement) are perceived to influence the effect of interventions [9, 13, 14]. Some studies have investigated the association between one or more of these process indicators and the outcome of school-based nutrition interventions, focusing mainly on fruit and vegetable intake [5-7]. The Pro Children study showed a positive association between delivered dose and change in fruit and vegetable intake [4]. In three other studies however, no such relation was found [5-7]. Children's appreciation of Pro Children and Fruits and Vegetables Make the Marks showed positive associations with change in fruit and vegetable intake [4, 5], whereas teacher appreciation and student appreciation of Project Tomato were not related to change in fruit and vegetable intake [8]. The observed fidelity of the Gimme 5 programme was not significantly associated with fruit and vegetable intake [6].

From research on the effects of mass media campaigns, it seems that the process indicator interpersonal communication can be an important factor for obtaining behavioural change, representing the extent to which people talk about the programme [16-18]. Children may tell one another whether they liked the programme and discuss what they learned [19]. This kind of communication may enhance the effect of the message on children's attitudes, intentions and behaviour [17-19], possibly by memory facilitation, persuasive influence, social support and increases in self-efficacy [17]. So far, no study on school-based nutrition programmes has included interpersonal communication as a process indicator.

The current study focuses on the nutrition education programme Taste Lessons for Dutch primary schools, which aims to interest children in taste, health and food quality. Effect evaluation of Taste Lessons showed significant positive effects on

several psychosocial determinants towards tasting unfamiliar foods and eating healthily and a variety of foods [20]. To investigate how the implementation process contributed to these programme outcomes, the current study aims to provide insight into the programme delivery by studying delivered dose, appreciation and interpersonal communication, and to assess the association between these three process indicators and seven psychosocial determinants relevant to tasting unfamiliar foods and eating healthily and a variety of foods.

Methods

Intervention design

Taste Lessons (Smaaklessen) is a national school-based nutrition education programme for grades 1–8 (4–12-year-olds) in primary schools [21]. During an introductory workshop, teachers are trained in how to implement the lessons, and they receive a toolkit with teacher manuals and materials. The programme consists of 10–12 lessons per two grades, with lesson length ranging from 45 minutes to 2 hours. Each lesson has 3–9 standard and optional activities that teachers can select to implement in their classroom, including taste-testing, conducting experiments and homework assignments.

Study design and procedure

The current study was part of a larger effect evaluation with a quasi-experimental design and was carried out among twelve schools that implemented Taste Lessons in the 2011–2012 school year. Data were collected by means of questionnaires at baseline (September–December 2011), one month after the intervention and six months after the intervention (February–June and September–December 2012). For data collection during both measurements, the schools were visited by the research team. After a short introduction by the researcher, children and teacher completed a questionnaire in their classroom; this took approximately 30 minutes. During the second follow-up measurement, the same procedure was followed for nine schools, whereas in three other schools the questionnaires were distributed by the teachers themselves because the original classes had been split or the schools had no time for a visit from the research team. Children completed a questionnaire on psychosocial determinants (outcome measures) at all three time points and an additional appreciation questionnaire during the first follow-up measurement. For the latter questionnaire, the teacher recapitulated the lessons that the children had received to help them recall which activities were part of which lesson. Teachers completed a questionnaire on their background characteristics at baseline and a questionnaire on programme delivery and appreciation at the first follow-up measurement.

Study population

The study population consisted of Dutch primary schools that registered for Taste Lessons and attended an introductory workshop between September and November 2011. During the workshop, these schools were invited by a member of the research team to participate if they intended to teach Taste Lessons in grades 5–8 (8–12-year-olds), had not implemented Taste Lessons before and did not intend to participate in another nutrition-related programme. Twelve out of 37 schools were willing to participate and met the inclusion criteria (25 classes, 560 children). After the baseline measurement, four classes from different schools decided not to implement Taste Lessons in the relevant school year. The 392 remaining children (21 classes) completed the effect evaluation questionnaires at the first follow-up measurement (70% of the children in the baseline group). As the second follow-up measurement took place in the next school year, grade 8 children started that year in the first grade of secondary school and were excluded from the second follow-up measurement for practical reasons. Therefore, 296 children (18 classes) completed the effect evaluation questionnaire at the second follow-up measurement (53% of the children in the baseline group). The process evaluation questionnaires were completed at the first follow-up measurement by 18 out of 20 teachers (one teacher gave lessons to two classes) and the child appreciation forms by 339 of the 392 children (86%).

Measures

Process indicators

The process evaluation questionnaires for both the teachers and the children included closed and open questions, and were based on questionnaires used for the evaluation of the Dutch nutrition education programme Krachtvoer [22].

Dose. Teachers could indicate on a checklist for each lesson which standard activities they had implemented. The proportion of implemented standard activities was calculated for each class by dividing the total number of implemented activities by the total number of activities on the curriculum.

Appreciation. For each implemented lesson, the teacher's questionnaire measured the extent to which the teachers appreciated the lesson (scale 1–10), how much they liked the lesson and how feasible the lesson was to implement (scale 1 = not nice/not feasible to 5 = very nice/feasible, respectively). In addition, more detailed information on programme delivery, such as perceived constraints and opinion on the programme materials, was assessed with open questions. For each implemented lesson, the children's questionnaire measured the extent to which they liked the lesson (scale 1–10).

Additionally, the questionnaire assessed appreciation of specific activities (e.g. taste-testing and home assignments, scale 1–10) and how they appreciated Taste Lessons in general (scale 1 = not nice to 5 = very nice).

Interpersonal communication. One question on the children's appreciation questionnaire assessed how often children talked about Taste Lessons with others after the lessons (scale 1 = never to 5 = always).

Psychosocial determinants

The outcome measure of the Taste Lessons effect evaluation was children's change in psychosocial determinants towards tasting unfamiliar products and eating healthily and a variety of foods. The psychosocial determinants selected were knowledge, awareness, skills, attitude, emotion, subjective norm (of classmates, parents and teacher) and intention. Children's knowledge (six questions, scale true or false) and skills (four questions, able to perform the skill, scale 'no', 'a little' or 'yes') were assessed by questions on what they were taught during Taste Lessons. Awareness was measured by questions on how often children performed the target behaviours (scale 1 = never to 5 = always). Questions and scales for attitude and emotion ('how much do you think the target behaviours are clever/interesting and nice/cool/tasty?'), subjective norm ('how much do you think your classmates/parents/ teacher want you to perform the target behaviours?') and intention ('how much are you planning to perform the target behaviours?') were used as described by Ajzen and Fishbein [23] (scale 1 = no, not at all to 5 = yes, totally). A questionnaire was developed to be filled out by the children themselves and pretested. Reliability analyses of the baseline data showed Cronbach's α >0.6 for all constructs, and mean scores were used in further analyses. For knowledge, the criteria of the facility index and item discrimination were used to exclude questions, and the score for correct answers was used for further analyses [24]. Change scores were calculated as the difference between the children's mean score at the baseline measurement and at the follow-up measurements [25].

Socio-demographic characteristics

The children's questionnaire at baseline included questions on age (in years), sex and ethnicity of the children and their parents (country of birth). Children were classified as non-native if they or one of their parents were born outside the Netherlands. In the teacher's questionnaire at baseline, sex and years of teaching experience were assessed. Information on the schools' characteristics was obtained from the online database of Dutch primary schools [26], including location (city, small city or town), principle (religious or public) and school size (small [<150 pupils], medium [150–400 pupils] or large [>400 pupils]).

Statistical analysis

Descriptive analyses were performed, using SPSS Statistics (version 19.0) to describe the socio-demographic characteristics and process indicators. Subsequently, the association between the process indicators and change in psychosocial determinants was assessed for both follow-up measurements compared to baseline, for grades 5–8 together. Multivariate linear regression analyses were performed by use of the programme HLM (version 7) to adjust for a clustering effect of children within the same class and school, including three levels: (1) pupil, (2) class and (3) school. Changes in the psychosocial determinant scores were used as dependent variables. The process indicators dose (proportion of standard activities received, score 0–1), teacher and children

Table 1. Descriptive statistics of the study population by children, teacher and school characteristics.

	Total		Grades 5–6		Grades 7–8	
	N	Mean (SD) or %	N	Mean (SD) or %	N	Mean (SD) or %
Children characteristics (n=392)						
Age (years)	392	9.6 (1.3)	224	8.7 (0.7)	168	10.8 (0.7)
Sex – girls	179	45.7	107	47.8	72	42.9
Ethnicity – native[1]	247	63.0	145	64.7	102	60.7
Teacher characteristics (n=20)[2]						
Sex – female	18	90.0	11	84.6	6	75.0
Teaching experience (years)[3]	18	17.1 (13.4)	11	19.0 (14.6)	8	14.4 (11.9)
School characteristics (n=392)						
Location						
- Village	129	32.9	97	43.3	32	19.0
- Small city	211	53.8	111	49.6	100	59.5
- City	52	13.3	16	7.1	36	21.4
Principle						
- Public	106	27.0	47	21.0	59	35.1
- Religious	286	73.0	177	79.0	109	64.9
School size						
- Small	145	37.0	71	31.7	74	44.0
- Medium	247	63.0	153	68.3	94	56.0
- Large	0	0.0	0	0.0	0	0.0

[1] Grades 5–8: 28 missing (7%), grades 5–6: 5 missing (2%), grades 7–8: 23 missing (14%). [2] One male teacher had a grade 6–7 class. [3] Two teachers' data are missing.

appreciation (mean score on liking of Taste Lessons, both scale 1–5) and the extent to which children talked about the lessons (mean score on interpersonal communication, scale 1–5) were used as explanatory variables in separate analyses. Analyses were adjusted for children's sex and baseline age. Results were interpreted as significant when $p<0.05$.

Table 2. Teacher's and children's score on the process indicators dose, appreciation and interpersonal communication.

	Total		Grades 5–6		Grades 7–8	
	N	Mean (SD)	N	Mean (SD)	N	Mean (SD)
Teacher questionnaire (n=18)						
Dose						
- Number of lessons[1]	18	4.6 (3.2)	10	5.5 (4.1)	8	3.5 (1.2)
- Number of activities[2]	18	18.9 (16.0)	10	25.3 (19.0)	8	10.9 (5.3)
- Proportion of activities (0–1)	18	0.3 (0.2)	10	0.3 (0.3)	8	0.2 (0.1)
Appreciation						
- Score (1–10)	18	7.9 (0.8)	10	7.7 (0.7)	8	8.3 (0.9)
- Liking (1–5)	18	4.4 (0.4)	10	4.4 (0.4)	8	4.4 (0.5)
- Feasible (1–5)	18	4.1 (0.7)	10	3.9 (0.7)	8	4.3 (0.6)
Child questionnaire (n=339)						
Appreciation						
- Score (1–10)	339	7.9 (2.0)	199	8.5 (1.8)	140	7.2 (2.0)
- Liking (1–5)	331	4.0 (1.0)	180	4.3 (0.8)	151	3.6 (1.1)
Appreciation of activities (score 1–10)						
- Taste-testing	334	8.5 (2.2)	191	8.9 (1.8)	143	7.9 (2.4)
- Conducting experiments	307	8.7 (1.8)	181	9.0 (1.7)	126	8.3 (1.9)
- Looking for information	199	6.3 (2.5)	97	6.5 (2.8)	102	6.2 (2.2)
- Talking about nutrition	309	6.6 (2.4)	174	7.1 (2.5)	135	6.0 (2.1)
- Learning about taste and food	306	7.1 (2.4)	174	7.9 (2.2)	134	6.0 (2.4)
Interpersonal communication (1–5)	331	2.8 (1.1)	180	2.8 (1.1)	151	2.7 (1.1)

[1] Lessons for grades 5–6 range from 1–12, for grades 7–8 from 1–10.

[2] Activities for grades 5–6 range from 1–75, for grades 7–8 from 1–52.

Results

Characteristics of the study population

The study sample consisted of 392 children (224 children in grades 5–6, 168 children in grades 7–8), with a mean age of 9.6 years at baseline (Table 1). Of the 20 teachers that implemented Taste Lessons, most were female and had on average 16.7 years of teaching experience.

Programme delivery

Teachers implemented on average 4.6 lessons and 28% of the activities (Table 2). Grades 5–6 teachers implemented on average more lessons and activities than grades 7–8 teachers. Furthermore, lessons at the beginning of the curriculum were more often implemented than lessons at the end of the curriculum.

Teachers were positive about Taste Lessons, with a mean score of 7.9 (Table 2) and perceived the lessons to be nice and feasible to implement. Teachers perceived the Taste Lessons materials and curriculum as attractive, informative, and a good way to keep children engaged and to teach them about food and nutrition.

Children were positive about the Taste Lessons as well (mean score 7.8). Children from grades 5–6 had a higher appreciation of Taste Lessons than children from grades 7–8. In general, children were most positive about practical activities such as taste-testing and conducting experiments. Theoretical activities were rated lower but still positively, with mean scores between 6.3 and 7.1.

Children scored moderately on interpersonal communication, with similar scores for grades 5–6 and grades 7–8. Most of the children talked (almost) never (40%) or sometimes (37%) about the lessons afterwards, whereas 24% of the children talked (almost) always with others about Taste Lessons after they had taken place.

Association between the process indicators and the programme outcomes

At the first follow-up measurement, positive associations were found between dose and all psychosocial determinant change scores, but a significant dose–response relation was only shown for change in subjective norm of the teacher ($p<0.03$, Table 3). At the second follow-up measurement, the general trend in associations was still positive, but no significant associations were found.

Teacher appreciation showed inverse associations with change in almost all determinants at both measurements, of which change in attitude and subjective norm of the teacher at the first follow-up measurement were significant

Table 3 Associations between the process indicators and changes in the psychosocial determinants[1]

	Dose		Appreciation (teacher)		Appreciation (children)		Interpersonal communication	
	Follow-up 1 (N=338) β (SE)	Follow-up 2 (N=249) β (SE)	Follow-up 1 (N=338) β (SE)	Follow-up 2 (N=249) β (SE)	Follow-up 1 (N=296) β (SE)	Follow-up 2 (N=206) β (SE)	Follow-up 1 (N=296) β (SE)	Follow-up 2 (N=205) β (SE)
Knowledge	0.0 (0.1)	0.0 (0.1)	-0.1 (0.0)	-0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)*	0.0 (0.0)
Awareness	0.6 (0.3)	0.4 (0.4)	-0.2 (0.1)	-0.4 (0.2)	0.1 (0.1)*	0.1 (0.1)	0.1 (0.0)*	0.1 (0.1)
Skills	0.0 (0.1)	0.1 (0.2)	0.1 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Attitude	-0.1 (0.3)	-0.5 (0.3)	-0.2 (0.1)*	-0.2 (0.2)	0.1 (0.1)	0.2 (0.1)**	0.2 (0.0)***	0.2 (0.1)**
Emotion	0.1 (0.3)	0.4 (0.3)	-0.2 (0.1)	-0.1 (0.2)	0.1 (0.1)**	0.1 (0.1)	0.2 (0.0)***	0.1 (0.1)
Subjective norm – classmates	0.3 (0.4)	0.0 (0.5)	-0.1 (0.2)	-0.5 (0.2)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)
Subjective norm – parents	0.4 (0.2)	0.1 (0.3)	-0.1 (0.1)	-0.1 (0.1)	0.1 (0.0)	0.1 (0.1)*	0.0 (0.0)	0.0 (0.1)
Subjective norm – teacher	1.2 (0.4)*	1.0 (0.4)	-0.5 (0.2)*	-0.2 (0.2)	0.2 (0.1)**	0.1 (0.1)	0.1 (0.1)	-0.1 (0.1)
Intention	0.1 (0.2)	-0.3 (0.4)	-0.1 (0.1)	-0.3 (0.2)	0.1 (0.1)	0.1 (0.1)	0.2 (0.0)***	0.2 (0.1)**

[1] For grades 5–8 together, with children who filled in at least 75% of the questions in the constructs, and adjusted for children's sex and baseline age.

* p<0.05, ** p <0.01, *** p <0.001

(both $p<0.05$). An opposite trend was observed for children. The better the children appreciated Taste Lessons, the more positive change they showed in the determinants. Children's appreciation was significantly positively associated with change in awareness ($p<0.05$), emotion ($p<0.01$) and subjective norm of the teacher ($p<0.01$) at the first follow-up measurement. Six months after the intervention, these significant positive associations were still significant for change in attitude ($p<0.01$) and subjective norm of the parents ($p<0.05$).

Interpersonal communication was positively related to almost all determinants at both follow-up measurements. Significant associations were found for change in knowledge and awareness (both $p<0.05$), and attitude, emotion and intention (all $p<0.001$) one month after Taste Lessons. During the second follow-up measurement, talking about Taste Lessons remained significantly positively associated with change in attitude and intention (both $p<0.01$).

Discussion

The aim of this study was to provide insight into the programme delivery of Taste Lessons, and to investigate the extent to which process indicators could indicate programme effect on psychosocial determinants. Taste Lessons was positively appreciated by both teachers and children. Mainly due to time and money constraints however, teachers implemented only some of the lessons and activities. Process indicators reflecting different aspects of the programme delivery were associated with the measured outcomes differently. Children's appreciation and interpersonal communication both showed significant positive associations with change in awareness, attitude and emotion, whereas children's appreciation and dose were both significantly associated with subjective norm of the teacher. In addition, interpersonal communication was significantly associated with change in children's knowledge and intention towards tasting unfamiliar food and eating healthily and a variety of foods. Remarkably, teacher appreciation was negatively associated with changes in determinants.

The fact that all the data in this study were collected using self-report may have led to socially desirable answers and measurement errors. However, to reduce measurement errors, questions and answers were formulated to be child-friendly and the questionnaire was pretested. Furthermore, children completed the questionnaires under supervision of the research team, who also instructed the children on how to fill in the questionnaires and were available for questions.

In this study, process indicators and effect were studied in a real-life setting, without strict guidelines for teachers about which lessons or activities to

implement. Teachers were instructed on how to implement Taste Lessons during the introductory workshop. They were, however, free to implement Taste Lessons in either a project week or lessons spread over a longer period of time and were not obliged to implement all the programme lessons and activities. In general, this resulted in high appreciation and feasibility, but incomplete implementation of the programme, with a mean delivered dose of around one-third of the available activities and 35% to 45% of the lessons implemented in the classroom. In other studies, a higher delivered dose of activities is reported, ranging from 47% to 91% of activities implemented [6, 27-31] or 45% to 95% of the curriculum lessons implemented [7-9, 30, 32, 33]. However, those programmes were implemented in other countries, were in some studies delivered by research staff [27] and teachers may have been stimulated to implement the whole curriculum.

The received dose of Taste Lessons was a predictor of change in subjective norm of the teacher only. It is plausible that the more teachers taught children about nutrition, the more children perceived that the teacher wanted them to taste unfamiliar products and eat healthy and a variety of foods. This study found no significant relation between self-reported dose and other determinants, such as knowledge. A study on the programme Gimme 5 found a positive association between interview-assessed dose and health knowledge, but no association between self-reported dose and health knowledge [6]. Gray et al.'s study [9] found significantly higher increases in psychosocial determinants, such as self-efficacy and intention, towards most of the measured healthy eating behaviours in classes with a higher delivered dose than in classes with a lower delivered dose. Other studies found positive [4] or no associations [5, 7] between delivered dose and the behavioural outcome fruit and vegetable intake. Durlak and DuPre [13] suggest that it is not realistic to expect complete implementation, but positive results have often been obtained with around 60% implementation. It could also be that using only a number of activities as a measure of dose and not a certain type of activity (such as taste-testing or other practical activities) could have underestimated the dose–response effect. More research has to be done to explore whether there is a threshold of exposure to (certain elements of) the programme required to achieve desired effects.

Teacher appreciation of Taste Lessons was positive in this study, but the more positive teachers were about the curriculum, the less positive changes were found in children's psychosocial determinants. Teachers who were contacted to discuss these remarkable findings could not provide an explanation for this effect. To our knowledge, only Christian et al.'s evaluation study [8] on Project Tomato assessed the relation between teacher appreciation and programme

effects, and no relation was found. However, teacher appreciation (satisfaction with both the curriculum materials and teaching the curriculum) significantly correlated with student satisfaction in Gray et al.'s study [9]. In their evaluation model, Gray et al. hypothesised that teacher appreciation links to delivered dose and children's engagement and appreciation, but not directly to programme outcomes [9]. Teacher appreciation might therefore not be the right (direct) indicator for effectiveness of the programme. This hypothesis might be supported by Dusenbury et al.'s finding [14] that teacher self-reports about adaptations to the programme negatively correlated to observations.

Children's appreciation in our study was positively associated with change in psychosocial determinants. Especially strong associations were found with attitude and emotion, which are determinants that are closely linked to perceptions of liking. Other studies that have looked at the relation between children's appreciation and programme effect found either significant positive associations using categorical appreciation scores [4, 5, 9] or no significant associations using a continuous appreciation score [8]. Positive children's appreciation seems therefore to be more indicative of programme effects than teacher appreciation.

In the current study, significant associations were found between interpersonal communication about Taste Lessons and the change in most of the selected psychosocial determinants, especially after one month. To our knowledge, talking about a programme has been extensively studied only in mass media campaigns [16-18]. In particular, emotionally engaging messages or activities are promising means to increase the likelihood of conversation, but the topic and the person that is talked with are important factors for obtaining effect [17]. Intervention effects of Taste Lessons via interpersonal communication may be enhanced if attractive activities, such as experiments, are used, and if teachers are able to get the children fascinated by the topic. This overlaps with enthusiasm of the teacher and engagement of the children as potential factors for influencing implementation [9, 13, 14]. The results in the current study were obtained from a single question on conversational occurrence. Conversation content and which persons were talked with were not assessed. Further research is therefore necessary to unravel the relation between interpersonal communication and programme outcomes.

Conclusions

From the results it can be concluded that delivered dose, children's appreciation and interpersonal communication are indicators of a positive programme effect on psychosocial determinants towards tasting unfamiliar foods and eating healthily and a variety of foods. Therefore, process evaluation provides insight into factors that contribute to the effect of interventions in real-life settings.

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References

1. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: A systematic review. Preventive Medicine. 2006;42(2):85-95.
2. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1A):131-9.
3. Van Cauwenberghe E, Maes L, Spittaels H, van Lenthe FJ, Brug J, Oppert JM, et al. Effectiveness of school-based interventions in Europe to promote healthy nutrition in children and adolescents: systematic review of published and 'grey' literature. The British journal of nutrition. 2010;103(6):781-97.
4. Wind M, Bjelland M, Pérez-Rodrigo C, te Velde SJ, Hildonen C, Bere E, et al. Appreciation and implementation of a school-based intervention are associated with changes in fruit and vegetable intake in 10- to 13-year old schoolchildren—the Pro Children study. Health Education Research. 2008;23(6):997-1007.
5. Bere E, Veierød MB, Bjelland M, Klepp K-I. Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM). Health Education Research. 2006;21(2):258-67.
6. Resnicow K, Davis M, Smith M, Lazarus-Yaroch A, Baranowski T, Baranowski J, et al. How best to measure implementation of school health curricula: a comparison of three measures. Health Education Research. 1998;13(2):239-50.
7. Story M, Mays RW, Bishop DB, Perry CL, Taylor G, Smyth M, et al. 5-a-Day Power Plus: Process Evaluation of a Multicomponent Elementary School Program to Increase Fruit and Vegetable Consumption. Health Education & Behavior. 2000;27(2):187-200.
8. Christian M, Evans C, Ransley JK, Greenwood DC, Thomas J, Cade J. Process evaluation of a cluster randomised controlled trial of a school-based fruit and vegetable intervention: Project Tomato. Public Health Nutrition. 2012;15(3):459-65.
9. Gray HL, Contento IR, Koch PA. Linking implementation process to intervention outcomes in a middle school obesity prevention curriculum, 'Choice, Control and Change'. Health Education Research. 2015;30(2):248-61.
10. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
11. Steckler A, Linnan L. Process evaluation for public health interventions and research San Francisco, CA: Jossey-Bass; 2002.
12. van Nassau F, Singh AS, van Mechelen W, Brug J, Chinapaw MJM. Implementation evaluation of school-based obesity prevention programmes in youth; how, what and why? Public Health Nutrition. 2015;18(09):1531-4.
13. Durlak J, DuPre E. Implementation Matters: A Review of Research on the Influence of Implementation on Program Outcomes and the Factors Affecting Implementation. American Journal of Community Psychology. 2008;41(3):327-50.
14. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Health Education Research. 2005;20(3):308-13.
15. Saunders RP, Evans MH, Joshi P. Developing a Process-Evaluation Plan for Assessing Health Promotion Program Implementation: A How-To Guide. Health Promot Pract. 2005;6(2):134-47.
16. van den Putte B, Yzer M, Southwell BG, de Bruin G-J, WIllemsen MC. Interpersonal Communication as an Indirect Pathway for the Effect of Antismoking Media Content on Smoking Cessation. J Health Commun. 2011;16:470 - 85.
17. Dunlop SM, Kashima Y, Wakefield M. Predictors and Consequences of Conversations About Health Promoting Media Messages. Communication Monographs. 2010;77(4):518-39.
18. Hendriks H, van den Putte B, de Bruijn G-J, de Vreese CH. Predicting Health: The Interplay Between Interpersonal Communication and Health Campaigns. J Health Commun. 2014;19(5):625-36.
19. van den Putte B, Yzer M, Southwell BG, de Bruijn G-J, Willemsen MC. Interpersonal Communication as an Indirect Pathway for the Effect of Antismoking Media Content on Smoking Cessation. J Health Commun. 2011;16(5):470-85.
20. Battjes-Fries M, Haveman-Nies A, Renes R, Meester H, van 't Veer P. Effect of the Dutch school-based education programme 'Taste Lessons' on behavioural determinants of taste acceptance and healthy eating: a quasi-experimental study. Public Health Nutrition. 2015; 18(12):2231-41.

21. Smaaklessen Wageningen: Steunpunt Smaaklessen & Schoolgruiten 2012 [cited 2012 December]. Available from: www.smaaklessen.nl.
22. Bessems KMHH, van Assema P, Martens MK, Paulussen TWGM, Raaijmakers LGM, De Vries NK. Appreciation and implementation of the Krachtvoer healthy diet promotion programme for 12- to 14- year-old students of prevocational schools. BMC Public Health. 2011a;11(909).
23. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior: Englewood Cliffs, NJ: Prentice-Hall; 1980.
24. Parmenter K, Wardle J. Evaluation and Design of Nutrition Knowledge Measures. Journal of Nutrition Education. 2000;32(5):269-77.
25. Van Breukelen GJP. ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. Journal of Clinical Epidemiology. 2006;59(9):920-5.
26. Onderwijsdata - primair onderwijs: Dienst Uitvoering Onderwijs - Ministerie van Onderwijs, Cultuur en Wetenschap; [cited 2012 December]. Available from: www.duo.nl.
27. Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, et al. Increasing the Fruit and Vegetable Consumption of Fourth-Graders: Results from the High 5 Project. Preventive Medicine. 2000;30(4):309-19.
28. Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, et al. Gimme 5 Fruit, Juice, and Vegetables for Fun and Health: Outcome Evaluation. Health Education & Behavior. 2000;27(1):96-111.
29. Baranowski T, Stables G. Process Evaluations of the 5-a-Day Projects. Health Education & Behavior. 2000;27(2):157-66.
30. Perry CL, Sellers DE, Johnson C, Pedersen S, Bachman KJ, Parcel GS, et al. The Child and Adolescent Trial for Cardiovascular Health (CATCH): Intervention, Implementation, and Feasibility for Elementary Schools in the United States. Health Education and Behavior. 1997;24(6):716-35.
31. Day ME, Strange KS, McKay HA, Naylor PJ. Action schools! BC - Healthy eating: Effects of a whole-school model to modifying eating behaviours of elementary school children. Canadian Journal of Public Health. 2008;99(4):328-31.
32. Steckler A, Ethelbah B, Martin CJ, Stewart D, Pardilla M, Gittelsohn J, et al. Pathways process evaluation results: a school-based prevention trial to promote healthful diet and physical activity in American Indian third, fourth, and fifth grade students. Preventive Medicine. 2003;37, Supplement 1(0):S80-S90.
33. Gortmaker S, Cheung LY, Peterson KE, et al. Impact of a school-based interdisciplinary intervention on diet and physical activity among urban primary school children: Eat well and keep moving. Archives of Pediatrics & Adolescent Medicine. 1999;153(9):975-83.

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3

Effectiveness of Taste Lessons with and without additional experiential learning activities on children's psychosocial determinants of vegetables consumption

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Abstract

Introduction

Experiential learning methods seem to be promising to enhance healthy eating behaviour in children. Therefore, this study compared the effectiveness of the Dutch programme Taste Lessons with and without additional experiential learning activities on children's psychosocial determinants of vegetable consumption.

Methods

In a quasi-experimental design, 800 children (8–11 years old) from 34 primary schools participated in a Taste Lessons (TL) group, a Taste Lessons Vegetable Menu (TLVM: TL with added experiential learning) group, and a control group. During a baseline and follow-up measurement, children completed a questionnaire on psychosocial determinants towards vegetables consumption. Multilevel regression analyses were conducted to compare individual changes in the determinants in the TLVM group with those in the TL group, and in the two intervention groups with those in the control group.

Results

The TLVM group showed a significantly higher increase in knowledge (d=0.5, $p<0.001$), attitude and subjective norm of the teacher (both d=0.2, $p<0.05$), whereas the TL group only showed a significantly higher increase in knowledge (d=0.4, $p<0.001$) compared to the control group. Increases in knowledge (d=0.2, $p<0.10$), subjective norm (d=0.2, $p<0.10$) and cooking self-efficacy (d=0.2, $p<0.05$) were higher in the TLVM group than in the TL group.

Conclusions

More and stronger effects were found in children who participated in the additional hands-on activities.

Introduction

Over the last two decades, a wide array of school-based nutrition education programmes has been developed to enhance children's healthy eating behaviour [1]. Evaluation studies show varying effects of these programmes, from changes in psychosocial determinants to changes in actual eating behaviour [1-6].

Literature suggests that, to be more effective, school-based nutrition education programmes should not only provide information on healthy eating behaviour, but also enhance knowledge and skills regarding production, preparation and preservation of food [1, 2]. Furthermore, programmes may be more effective when they involve parents [1-4, 6] and other community members in a multicomponent approach [1, 5, 7]. Finally, Peters et al. [4] suggest that programmes are more effective when they use varying teaching methods with an active, interactive, multimodal and multiple setting format. Hands-on activities such as tasting, cooking and gardening have become more popular [1, 6, 8-12]. Such activities are highly liked by children and may enhance effectiveness by creating feelings of ownership and pride [10, 13-16]. A review by Robinson-Brien et al. [8] shows that programmes including nutrition lessons, gardening activities and food preparation activities are in general more effective in increasing children's fruit and vegetable intake than nutrition lessons only.

The current study focuses on the Dutch nutrition education programme 'Taste Lessons' for primary schools, which aims to interest children in taste, health and food quality [17]. To improve effectiveness, the 'Taste Lessons Vegetables Menu' has been developed for the sixth and seventh grade of primary schools, including the five lessons of Taste Lessons and four additional activities. These additional activities include repetition and deepening understanding of the lessons by involving the children in each step of the food chain with various hands-on activities and a more extensive involvement of parents and other community members. The purpose of this study was to compare the effectiveness of Taste Lessons with Taste Lessons with additional experiential learning activities (Taste Lessons Vegetable Menu) on children's psychosocial determinants of vegetable consumption.

Methods

Intervention design

Taste Lessons (Smaaklessen) is a national, school-based nutrition education programme, developed in 2006 by the Netherlands Nutrition Centre and Wageningen University for primary school grades 1–8 (children aged 4–12 years). In 2013, the programme materials were rearranged into five lessons per grade around the themes taste development, eating healthily, food production, consumer skills and cooking. Each lesson takes on average 45 minutes and consists of several teaching methods, including an introductory group talk, a hands-on activity and an evaluation group talk (details shown in Table 1).

In 2013, a format was developed in which Taste Lessons (TL) is extended with additional hands-on activities for the five basic food groups. The Taste Lessons Vegetable Menu (TLVM) for grades 6 and 7 was developed as a pilot to assess appreciation, feasibility and the added effectiveness of this extended format. In addition to the five lessons of Taste Lessons, the Taste Lessons Vegetable Menu contains four additional activities: a vegetable quiz, an excursion to a vegetable grower, a homework assignment for the children to perform with their parents in the supermarket, and a cooking lesson with a dietician and the parents (Table 1). The excursion and cooking lesson were arranged for the schools by the research team.

Data from process evaluation questionnaires revealed that teachers, parents and children highly appreciated TLVM and TL. On average, teachers implemented most of the lessons, with on average 4.7 and 4.5 of the five lessons in the TLVM and the TL group, respectively. Almost all teachers in the TLVM group went with their class to a vegetable grower, had a cooking lesson with a dietician and encouraged children to complete the supermarket home assignment with their parents, but only half of the teachers implemented the vegetable quiz. Parental process questionnaires, filled out by about one of 40% of children's parents, showed that 77% of the parents in the TLVM group completed the supermarket assignment with their child, 37% attended the cooking lesson and 18% helped with an (additional) activity.

Study design and procedure

A quasi-experimental design with three arms was used to assess the effectiveness of the Taste Lessons Vegetable Menu. The study was carried out among 1010 children in 34 primary schools. Of this group, 11 schools implemented the Taste Lessons Vegetable Menu (TLVM), 11 schools implemented Taste Lessons (TL) and 12 schools took part in the study as a control group. In February–

Table 1. Content of Taste Lessons (TL) and additional activities in Taste Lessons Vegetable Menu (TLVM)

Theme	Lessons in both TL and TLVM			Additional activities in TLVM		
	Name	Purpose	Methods	Name	Purpose	Methods
Taste development	Unknown, unloved	-Learn about taste development -Exposure to unfamiliar vegetables	-Introductory group talk -Tasting -Evaluation group talk -Homework assignment	Element in 'Excursion to the grower'	-Exposure to different kinds of vegetables	-Tasting
Eating healthily	Tasty from the Wheel of Five	-Learn about the Wheel of Five (Dutch food pyramid) -Learn about food recommendations	-Introductory group talk -Experimenting -Evaluation group talk	Vegetable quiz	-Learn about production, preparation, health regarding vegetables	-Playing a game -Competition
Food production	Where does our food come from?	-Learn about production and processing of foods	-Introductory group talk -Assignment -Group discussion -Evaluation group talk	Excursion to the grower	-Learn about sowing, processing and harvesting of vegetables -Develop several growing skills -Develop skills to prepare a vegetable meal using a recipe	-Introductory group talk -Demonstration -Growing -Cooking -Tasting -Evaluation group talk -Assignment
Consumer skills	Cucumber debate	-Learn about organic growing -Develop an opinion on organic foods -Learn about food labels to recognize organic foods	-Introductory group talk -Tasting -Debating -Group discussion -Evaluation group talk	Home assignment to perform in the supermarket with parents	-Develop skills to look up information about vegetables -Develop skills to weigh vegetables	-Introductory group talk -Assignment -Evaluation group talk
Cooking	Restaurant in the classroom	-Develop skills to prepare healthy snacks	-Introductory group talk -Cooking -Tasting -Evaluation group talk -Home assignment	Extension of the lesson with visit by dietician and the parents	-Same as lesson Restaurant in the classroom	-Same as lesson Restaurant in the classroom -Tastings with the parents -Evaluation of the group talk about the project by the dietician

April 2014, the research team visited all schools twice, for the baseline and follow-up measurements. The measurements were conducted in the week before and the week after the intervention period. The measurements in the control schools took place in the same period. Before the baseline measurement, children received a questionnaire on socio-demographic characteristics for their parents to complete at home (on paper or online). During the measurements, children were requested to complete a questionnaire in class, supervised by a research assistant, and to take part in an individual taste test in a separate room (results not described in this chapter). Furthermore, during the follow-up measurement, the teachers, children and parents in the TLVM and the TL group were asked to complete a process evaluation questionnaire.

Study population

The study took place in the Dutch province of Gelderland. To recruit schools, a list of primary schools in this province was consulted. From this list, 219 schools were randomly assigned to one of the three study groups (110 to the TLVM group, 54 to the TL group, and 56 to the control group) and invited by letter to take part in the study. Employees of the community health service reminded the schools by phone about recruitment for the study. Schools were included if they were not planning to participate in any other nutrition-related education programme and the children in grades 6 and 7 were not previously enrolled in TL. Eleven schools (417 children in 18 classes) participated in the TLVM group (10%), eleven schools (285 children in 13 classes) in the TL group (20%) and twelve schools (308 children in 18 classes) in the control group (21%) met the inclusion criteria and were willing to participate. All recruited classes participated in the baseline measurement and 949 of the 1010 children completed the baseline questionnaire (94%). All but one class in the control group participated in the follow-up measurement, resulting in 888 completed questionnaires (88%). In total, 800 children (79%) filled out both questionnaires and were included in the analyses.

Measures

Psychosocial determinants

A questionnaire was developed to measure the four determinants from Ajzen's Theory of Planned Behaviour [18]: self-efficacy, attitude, subjective norm and intention, as well as knowledge and awareness across the themes taste (tasting unfamiliar vegetables, one question), health (eating enough vegetables daily, one question), production (paying attention to the origin, production and processing of vegetables, three questions) and cooking (three questions on self-efficacy only). Children's knowledge on taste development (1 item), the recommended

daily intake of vegetables (1 item) and production of vegetables (3 items) was assessed by five multiple choice questions with four response options. A score of correct answers was used in the analyses. Questions and scales for awareness (for example: how often do you pay attention to tasting unfamiliar vegetables?), self-efficacy (do you think that you are able to taste unfamiliar vegetables?), attitude (do you think that tasting unfamiliar vegetables is good, nice, tasty and clever?), subjective norm (do you think that your parents/teachers want you to taste unfamiliar vegetables?) and intention (are you planning to taste unfamiliar vegetables?) were used as described by Ajzen and Fishbein [19] and formulated in a way that was simple and understandable for children. A five-point scale was used, ranging from 'strongly disagree' to 'strongly agree'. The questionnaire was piloted in a small sample of children of similar age, and sets of questions per determinant were analysed for internal consistency using data from the baseline measurement. All the sets of questions scored a Cronbach's $\alpha > 0.65$. In the data analyses, a sum score for knowledge and mean scores for the other determinants were used for children who answered at least 75% of the questions for all determinants. For the specified analyses per theme, single item scores were used for the themes taste and health, and mean scores were used for the themes production and cooking.

Socio-demographic factors

The child questionnaire included questions on date of birth and sex. The parent baseline questionnaire included questions on the ethnicity of the child and parents (country of birth), height and weight of the child, age, number of children in family, educational level (low, middle, high) and marital status (married, cohabiting, unmarried, divorced, widowed). Children were classified as non-Dutch if they or one of their parents were born outside the Netherlands. BMI was calculated by dividing the child's body weight (in kilograms) by height (in metres) squared. Their weight status was classified into normal weight and overweight using the IOTF standard definitions [20]. Data on the mothers' socio-demographic characteristics – age, educational level and marital status – were used. School characteristics were obtained from the online database of Dutch primary schools [21]. The database included: location (town (<10,000 inhabitants), semi-city (10,000–100,000 inhabitants), or city >100,000 inhabitants), religious principle (non-denominational or religious) and size of the school (small (<150 pupils), medium (150–400 pupils) or large (>400 pupils)). The teacher baseline questionnaire included questions on sex, age, years of teaching experience and experience in teaching nutrition education (yes/no). These socio-demographic factors were considered as potential confounders in further analyses.

Statistical analyses

SPSS (version 20.0) was used for descriptive analyses. First, the TLVM, the TL and the control group were compared on their socio-demographic characteristics at baseline by use of Chi-square and one-way ANOVA. Second, change scores of the determinants were calculated as the difference in item, sum or mean score between the baseline and follow-up measurement [22].

Multilevel analyses were performed using the programme HLM (version 7) to evaluate the effect of TLVM and TL on changes in the determinants, including three levels: (1) pupil, (2) class and (3) school. First, simple linear regression was used, with change scores of each determinant as the dependent variable and dummy variables for the study groups as explanatory variables, adjusting for children's age and sex. Second, potential confounders and effect modifiers were identified by adding all socio-demographic factors to the model one by one. From these analyses, none was found to be significant. Relative effect sizes were calculated for each determinant as Cohen's *d* [23]: the regression coefficient for the intervention (adjusted difference in change score between the intervention and the control group) divided by the total standard deviation of the change scores over all levels of the adjusted model. A Cohen's *d* of 0.2 is interpreted as a small, 0.5 as a medium and 0.8 as a large effect size [23].

Table 2. Socio-demographic characteristics of the children, mothers, teachers and schools.

	TLVM		TL		Control	
	N	% / Mean (SD)	N	% / Mean (SD)	N	% / Mean (SD)
Children (n=800)						
Age (in years)	331	10.4 (0.7)	237	10.3 (0.7)	232	10.4 (0.7)
Grade						
- Grade 6	178	54	114	48	121	52
- Grade 7	153	46	123	52	111	48
Sex						
- Boy	159	48	114	48	113	49
- Girl	172	52	123	52	119	51
Ethnicity[1]						
- Dutch	197	90	102	89	117	92
- Non-Dutch	22	10	13	11	10	8
Mothers (n=448)						
Age (in years)[2]*	214	40.6 (4.2)	108	42.2 (3.6)	115	41.3 (3.9)
Marital status						
- Married / cohabiting	208	94	98	89	106	91
- Unmarried / divorced / widowed	13	6	12	11	11	9
Educational level[3]*						
- Low	40	18	12	11	12	11
- Middle	112	52	54	51	61	53
- High	65	30	41	38	41	36
Teachers (n=47)						
Age (in years)	16	42.9 (13.5)	13	38.9 (10.7)	17	38.1 (10.8)
Teaching experience (in years)	16	18.3 (13.0)	13	15.5 (11.1)	18	11.8 (9.8)
Sex						
- Male	3	19	1	8	2	11
- Female	13	81	12	92	16	89
Schools (n=34)						
Religious principle						
- Non-denominational	3	27	5	46	6	50
- Religious	8	73	6	54	6	50
Size*						
- Small	2	18	8	73	9	75
- Medium	5	46	2	18	3	25
- Large	4	36	1	9	0	0
Location						
- Town	3	27	4	36	6	50
- Small city	7	64	4	36	2	17
- City	1	9	3	27	4	33

[1] Assessed by questions on country of birth in the parent's questionnaire, N=461. [2-3] N=437 and 438, respectively. * Significant difference between the three study groups.

Results

Characteristics of the study population

All three study groups included mainly children of Dutch origin (Table 2). Mean age of the children was similar in all three groups, with 10.3 years being the average. Mothers of children in the TLVM group were on average somewhat younger, had more children and were less educated than those in the TL and the control group. Teachers in the TLVM group were somewhat older and more experienced in teaching than those in the TL and the control group. Finally, the TLVM group included more large schools and more schools with a religious principle than the two other groups.

Effects on the psychosocial determinants

Children in both the TLVM and the TL group showed a significantly higher increase in knowledge than children in the control group (d=0.5 and d=0.4, respectively, both with p<0.001) (Table 3). The increase in knowledge in the TLVM group appeared higher, but was not significantly different from the TL group (d=0.2, p=0.08). Furthermore, the TLVM group showed a significantly higher increase in subjective norm of the teacher compared to the control group (d=0.2, p=0.01). This increase appeared also higher but was not significantly different compared with the TL group (d=0.2, p=0.07). Both the TLVM and the TL group showed a positive increase in attitude, but this was only significant for the TLVM group (d=0.2, p=0.04 and d=0.2, p=0.08, respectively). Finally, the TL group showed a positive, but not significant, effect on intention (d=0.2, p=0.06).

Effects specified by theme

Overall, the results of the specified analyses of the themes production, taste and health showed similar results as the main analyses (Table 4). The positive effects on knowledge, attitude, subjective norm of the teacher and intention originated mainly from effects on the taste and/or the production theme. In addition, the TLVM group showed a higher increase in cooking self-efficacy than the TL (d=0.2, p=0.02) and the control group (d=0.2, p=0.07).

Table 3. Mean scores, change scores and effect sizes for each psychosocial determinant[1]

	Mean score			Effect size	
	Baseline Mean (SD)	Follow-up Mean (SD)	Change Mean (SD)	TLVM / TL–Control Cohen's *d* (95% CI)	TLVM–TL Cohen's *d* (95% CI)
Knowledge					
- TLVM	2.3 (1.2)	3.3 (1.2)	1.0 (1.3)	0.5 (0.3–0.7)***	0.2 (0.0–0.3)
- TL	2.2 (1.2)	3.0 (1.2)	0.8 (1.4)	0.4 (0.2–0.5)***	
- Control	2.0 (1.1)	2.2 (1.2)	0.3 (1.2)		
Awareness					
- TLVM	2.5 (0.7)	2.4 (0.8)	-0.1 (0.8)	0.0 (-0.2–0.2)	-0.1 (-0.3–0.1)
- TL	2.5 (0.7)	2.4 (0.8)	0.0 (0.7)	0.1 (-0.1–0.3)	
- Control	2.6 (0.8)	2.4 (0.8)	-0.1 (0.7)		
Self-efficacy					
- TLVM	2.8 (0.7)	2.9 (0.8)	0.1 (0.6)	0.1 (-0.1–0.3)	0.1 (-0.1–0.2)
- TL	2.9 (0.7)	2.9 (0.7)	0.1 (0.6)	0.0 (-0.1–0.2)	
- Control	2.8 (0.7)	2.9 (0.8)	0.0 (0.6)		
Attitude					
- TLVM	3.0 (0.7)	3.0 (0.8)	0.0 (0.6)	0.2 (0.0–0.3)*	0.1 (-0.2–0.2)
- TL	3.0 (0.6)	3.0 (0.7)	0.0 (0.6)	0.2 (0.0–0.3)	
- Control	3.1 (0.7)	3.0 (0.8)	-0.1 (0.5)		
Subjective norm - parents					
- TLVM	3.0 (0.7)	3.0 (0.7)	0.0 (0.7)	0.1 (-0.1–0.2)	-0.0 (-0.2–0.1)
- TL	3.0 (0.7)	3.1 (0.7)	0.0 (0.7)	0.1 (-0.1–0.3)	
- Control	3.1 (0.7)	3.0 (0.7)	0.0 (0.7)		
Subjective norm - teacher					
- TLVM	3.1 (1.0)	3.5 (1.0)	0.4 (1.0)	0.2 (0.1–0.4)*	0.2 (0.0–0.4)
- TL	3.1 (0.9)	3.3 (0.9)	0.2 (0.9)	0.1 (-0.1–0.3)	
- Control	3.0 (1.0)	3.1 (1.1)	0.1 (0.9)		
Intention					
- TLVM	3.0 (0.9)	3.0 (0.9)	0.0 (0.8)	0.0 (-0.1–0.2)	-0.1 (-0.3–0.0)
- TL	2.9 (0.8)	3.0 (0.9)	0.1 (0.8)	0.2 (0.0–0.4)	
- Control	2.9 (0.9)	2.9 (0.9)	-0.1 (0.7)		

[1] Effect sizes are adjusted for children's age and sex. N=800. * p<0.05, ** p<0.01, *** p<0.001

Table 4. Effect sizes for each psychosocial determinant per theme[1]

	TLVM–Control Cohen's *d* (95% CI)	TL–Control Cohen's *d* (95% CI)	TLVM–TL Cohen's *d* (95% CI)
Knowledge			
- Taste	0.5 (0.3–0.8)***	0.4 (0.1–0.6)**	0.2 (-0.1–0.4)
- Health	0.0 (-0.2–0.2)	0.0 (-0.1–0.2)	0.0 (-0.2–0.2)
- Production	0.3 (0.2–0.5)***	0.2 (0.1–0.4)*	0.1 (-0.1–0.3)
Awareness			
- Taste	-0.1 (-0.3–0.1)	0.0 (-0.2–0.2)	-0.1 (-0.3–0.1)
- Health	-0.1 (-0.3–0.1)	0.0 (-0.2–0.1)	-0.1 (-0.3–0.1)
- Production	0.1 (-0.1–0.2)	0.2 (0.0–0.3)	-0.1 (-0.3–0.1)
Self-efficacy			
- Taste	0.0 (-0.1–0.2)	0.0 (-0.2–0.2)	0.1 (-0.1–0.3)
- Health	-0.1 (-0.3–0.1)	0.0 (-0.2–0.2)	-0.1 (-0.3–0.1)
- Production	0.0 (-0.1–0.2)	0.1 (0.0–0.3)	-0.1 (-0.3–0.1)
- Cooking	0.2 (0.0–0.3)	0.0 (-0.2–0.2)	0.2 (0.0–0.4)*
Attitude			
- Taste	0.0 (-0.2–0.2)	0.2 (0.0–0.4)*	-0.2 (-0.4–0.0)*
- Health	-0.1 (-0.2–0.1)	0.1 (-0.1–0.2)	-0.1 (-0.3–0.1)
- Production	0.2 (0.1–0.4)**	0.1 (-0.1–0.3)	0.1 (-0.1–0.3)
Subjective norm - parents			
- Taste	0.0 (-0.2–0.2)	0.1 (-0.1–0.3)	0.0 (-0.2–0.2)
- Health	0.0 (-0.1–0.2)	0.0 (-0.2–0.2)	0.0 (-0.1–0.2)
- Production	0.1 (-0.1–0.2)	0.1 (-0.1–0.3)	-0.1 (-0.2–0.1)
Subjective norm - teacher			
- Taste	0.2 (0.0–0.3)*	0.2 (0.0–0.4)	0.0 (-0.2–0.2)
- Health	0.1 (0.0–0.3)	0.1 (-0.1–0.3)	0.1 (-0.1–0.2)
- Production	0.2 (0.0–0.4)*	0.0 (-0.2–0.2)	0.2 (0.0–0.4)*
Intention			
- Taste	0.0 (-0.2–0.2)	0.0 (-0.2–0.1)	0.1 (-0.1–0.2)
- Health	0.0 (-0.2–0.2)	0.1 (-0.1–0.2)	-0.1 (-0.3–0.1)
- Production	0.0 (-0.1–0.2)	0.2 (0.1–0.4)*	-0.2 (-0.4– 0.0)*

[1] Effect sizes are adjusted for children's age and sex. N=800. * p<0.05, ** p<0.01, *** p<0.001

Discussion

Taste Lessons in combination with additional experiential learning activities was slightly more effective in increasing children's knowledge, subjective norm of the teacher and cooking self-efficacy than Taste Lessons without additional activities. Children receiving solely Taste Lessons showed similar but weaker results. The significant changes in both intervention groups originated mainly from changes with regard to tasting unfamiliar vegetables and paying attention to how vegetables are produced.

Both children who received TL and TLVM increased their knowledge more than children in the control group. This increase was of medium effect size for children who participated in additional activities and of small effect size for children who had the lessons only. A stronger effect on knowledge was also found in other studies comparing lessons only with lessons given in combination with gardening activities and/or cooking activities [7-9, 15]. It is reasonable to assume that repetition and extra information linked to concrete experiences might have contributed to the larger increase in knowledge. Liquori et al. [15] suggested that, based on Piaget's cognitive developmental theory, school-based nutrition education should emphasize concrete experiences with food rather than focus on abstract concepts, because knowledge is actively constructed from these experiences. Experiential learning methods might therefore be an effective strategy to increase children's knowledge.

The current study showed that children who participated in extra cooking activities during an excursion to a vegetable grower and an extended lesson provided by a dietician increased their self-efficacy for cooking more significantly than children who received a cooking lesson in-class with their own teacher. Evaluation of the Cooking with Kids programme also showed a higher effect on self-efficacy for cooking in children who participated in a cooking workshop compared to children who received nutrition lessons only [24]. The higher increase in perceived cooking skills might be explained by a higher exposure to cooking activities, facilitated by dieticians and growers. A cooking lesson takes effort in preparation time and organization for teachers. The cooking lesson, therefore, was sometimes skipped by teachers in the Taste Lessons group. Jones et al. [10] suggested that the development of cooking skills promotes healthier eating and encourages children to taste unfamiliar foods. Cooking might therefore be a promising method for school-based nutrition education to enhance healthy eating behaviours, and might be most effective when implemented by a skilled professional.

Children in the current study who received Taste Lessons showed a borderline

significant increase in subjective norm of the teacher towards tasting unfamiliar vegetables. In the previous Taste Lessons evaluation, a significant effect on subjective norm of the teacher was also found towards tasting unfamiliar foods [17]. Similarly, evaluation studies of the High 5 programme [25] with in-class nutrition lessons and a LAUSD multicomponent programme [7] found a small but significant effect on subjective norm of the teacher. Children who received Taste Lessons with additional activities showed an even higher increase in subjective norm of their teacher than children receiving Taste Lessons only, which was significant for subjective norm of paying attention to the production of vegetables. This suggests that higher exposure to nutrition education might indeed create an environment in which children are stimulated to taste vegetables and more consciously pay attention to how vegetables are produced.

The literature suggests that parental involvement enhances the effectiveness of school-based nutrition programmes [4, 6]. However, involving parents seems difficult, as many studies have reported low levels of participation [1, 3, 26]. In the current study, 77% of the parents completed the supermarket assignment with their child and 37% attended the cooking lesson with the dietician. This level of involvement is relatively high in comparison with, for example, the High 5 programme, where 43% of the parents helped with completing the homework assignments and 24% of the parents attended a kick-off session (25). Nevertheless, this level of parental involvement was still not sufficient to find an effect on children's subjective norm of their parents towards the target behaviours. In the High 5 evaluation study, no effect on children's subjective norm of their parents was found at the end of the intervention either [25]. It might be interesting to further explore ways to increase parental involvement and the added effectiveness of parental involvement in nutrition education programmes.

Experiential learning activities are promising ways to increase the effectiveness of school-based nutrition programmes [1, 6, 9-11, 14], because children get direct exposure to vegetables, create concrete experiences and might develop feelings of ownership and pride [13, 15, 16]. The literature suggests that children are therefore more likely to improve their attitudes towards tasting and eating vegetables, and increase their vegetable intake [8, 12]. The current study showed that adding experiential learning activities slightly increased the effect of Taste Lessons on knowledge, subjective norm of the teacher and cooking self-efficacy, but not increased effect on attitude and intention. Besides, the higher increases might indicate effect of experiential learning activities, but might also reflect impact of higher dose, professionally delivered activities and higher parental involvement. Further research is needed to explore whether experiential learning activities in nutrition education programmes such as Taste Lessons also increase children's willingness to taste unfamiliar vegetables and vegetable consumption.

Limitations

The demographic characteristics of the children, their parents, teachers and school in the TLVM group differed slightly from those in the TL and the control group. Mothers in the TLVM group were a bit younger and less educated, teachers were a bit more experienced in teaching and more schools were large and of religious principle compared to the other study groups. Although schools were asked to participate in the study in a randomly allocated study group, a selected group of schools might have agreed to implement the more intensive TLVM, and this may have resulted in these differences, although the mean scores on the outcome measures at baseline did not differ much between the groups. The observed effects did not change either when these potential confounders were corrected for, suggesting that the slight differences in the demographic characteristics did not have a major influence on the results of this study.

The use of questionnaires for children to fill out themselves may have induced socially desirable answers and measurement errors. When the questionnaire was being developed however, the questions and answers were formulated to be child-friendly, and the questionnaire was piloted among a number of children before the start of the study. Furthermore, a research assistant instructed the children on how to fill out the questionnaire properly and was available for questions.

To recruit schools for the intervention groups and enhance complete implementation, teachers were given the programme materials free of charge and received a small budget to finance necessary ingredients and materials. Teachers in the TLVM group were also facilitated in that the excursion to the vegetable grower and the cooking lesson with dietician were organized and financed for them. Teachers' limited budget is one of the biggest barriers to the complete implementation of Taste Lessons. The effects and appreciation found in this study might therefore be higher than when teachers have to implement the lessons and additional activities without financial support.

Conclusions

The results of this study show that Taste Lessons with additional hands-on activities appeared slightly more effective in increasing several psychosocial determinants of vegetable consumption than Taste Lessons without additional activities. More research is needed to explore how experiential learning activities can strengthen the effectiveness of school-based nutrition education in increasing children's vegetable consumption and other healthy and conscious eating behaviours.

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References

1. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1A):131-9.
2. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
3. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. Journal of Human Nutrition and Dietetics. 2005;18(6):431-43.
4. Peters LWH, Kok G, Ten Dam GTM, Buijs GJ, Paulussen TGWM. Effective elements of school health promotion across behavioral domains: a systematic review of reviews. BMC Public Health. 2009;9:182.
5. Evans CE, Christian MS, Cleghorn CL, Greenwood DC, Cade JE. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. The American Journal of Clinical Nutrition. 2012;96(4):889-901.
6. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: A systematic review. Preventive Medicine. 2006;42(2):85-95.
7. Prelip M, Kinsler J, Thai CL, Erausquin JT, Slusser W. Evaluation of a School-based Multicomponent Nutrition Education Program to Improve Young Children's Fruit and Vegetable Consumption. Journal of Nutrition Education and Behavior. 2012;44(4):310-8.
8. Robinson-O'Brien R, Story M, Heim S. Impact of Garden-Based Youth Nutrition Intervention Programs: A Review. Journal of the American Dietetic Association. 2009;109(2):273-80.
9. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students.
10. Jones M, Dailami N, Weitkamp E, Salmon D, Kimberlee R, Morley A, et al. Food sustainability education as a route to healthier eating: evaluation of a multi-component school programme in English primary schools. Health education research. 2012;27(3):448-58.
11. Bontrager Yoder AB, Liebhart JL, McCarty DJ, Meinen A, Schoeller D, Vargas C, et al. Farm to Elementary School Programming Increases Access to Fruits and Vegetables and Increases Their Consumption Among Those With Low Intake. Journal of Nutrition Education and Behavior. 2014;46(5):341-9.
12. Wang MC, Rauzon S, Studer N, Martin AC, Craig L, Merlo C, et al. Exposure to a Comprehensive School Intervention Increases Vegetable Consumption. Journal of Adolescent Health. 2010;47(1):74-82.
13. Heim S, Stang J, Ireland M. A Garden Pilot Project Enhances Fruit and Vegetable Consumption among Children. Journal of the American Dietetic Association. 2009;109(7):1220-6.
14. van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. Appetite. 2014;79(0):18-24.
15. Liquori T, Koch PD, Ruth Contento I, Castle J. The Cookshop Program: Outcome Evaluation of a Nutrition Education Program Linking Lunchroom Food Experiences with Classroom Cooking Experiences. Journal of Nutrition Education. 1998;30(5):302-13.
16. Bevan S, Vitale T, Wengreen H. Farm Field Trips Provide Sensory-based Experiences with Fresh, Local Produce. Journal of Nutrition Education and Behavior.44(3):278-9.
17. Battjes-Fries MC, Haveman-Nies A, Renes R-J, Meester HJ, van 't Veer P. Effect of the Dutch school-based education programme 'Taste Lessons' on behavioural determinants of taste acceptance and healthy eating: a quasi-experimental study. Public Health Nutrition. 2014; 2015 18: 2231-41.
18. Ajzen I. The theory of planned behavior. Organizational Behavior and Human Decision Processes. 1991;50(2):179-211.
19. Ajzen I, Fishbein M. Understanding attitudes and predicting social behavior: Englewood Cliffs, NJ: Prentice-Hall; 1980.
20. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320.7244:1240.
21. Onderwijsdata - primair onderwijs: Dienst Uitvoering Onderwijs - Ministerie van Onderwijs, Cultuur en Wetenschap; [cited 2012 December]. Available from: www.duo.nl.

22. Van Breukelen GJP. ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. Journal of Clinical Epidemiology. 2006;59(9):920-5.
23. Cohen J. A power primer. Psychol Bull. 1992;112(1):155-9.
24. Cunningham-Sabo L, Lohse B. Impact of a School-Based Cooking Curriculum for Fourth-Grade Students on Attitudes and Behaviors Is Influenced by Gender and Prior Cooking Experience. Journal of Nutrition Education and Behavior. 2014;46(2):110-20.
25. Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, et al. Increasing the Fruit and Vegetable Consumption of Fourth-Graders: Results from the High 5 Project. Preventive Medicine. 2000;30(4):309-19.
26. Blom-Hoffman J, Wilcox KR, Dunn L, Leff SS, Power TJ. Family Involvement in School-Based Health Promotion: Bringing Nutrition Information Home. School psychology review. 2008;37(4):567-77.

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4

Effectiveness of Taste Lessons with and without additional experiential learning activities on children's willingness to taste vegetables and vegetable consumption

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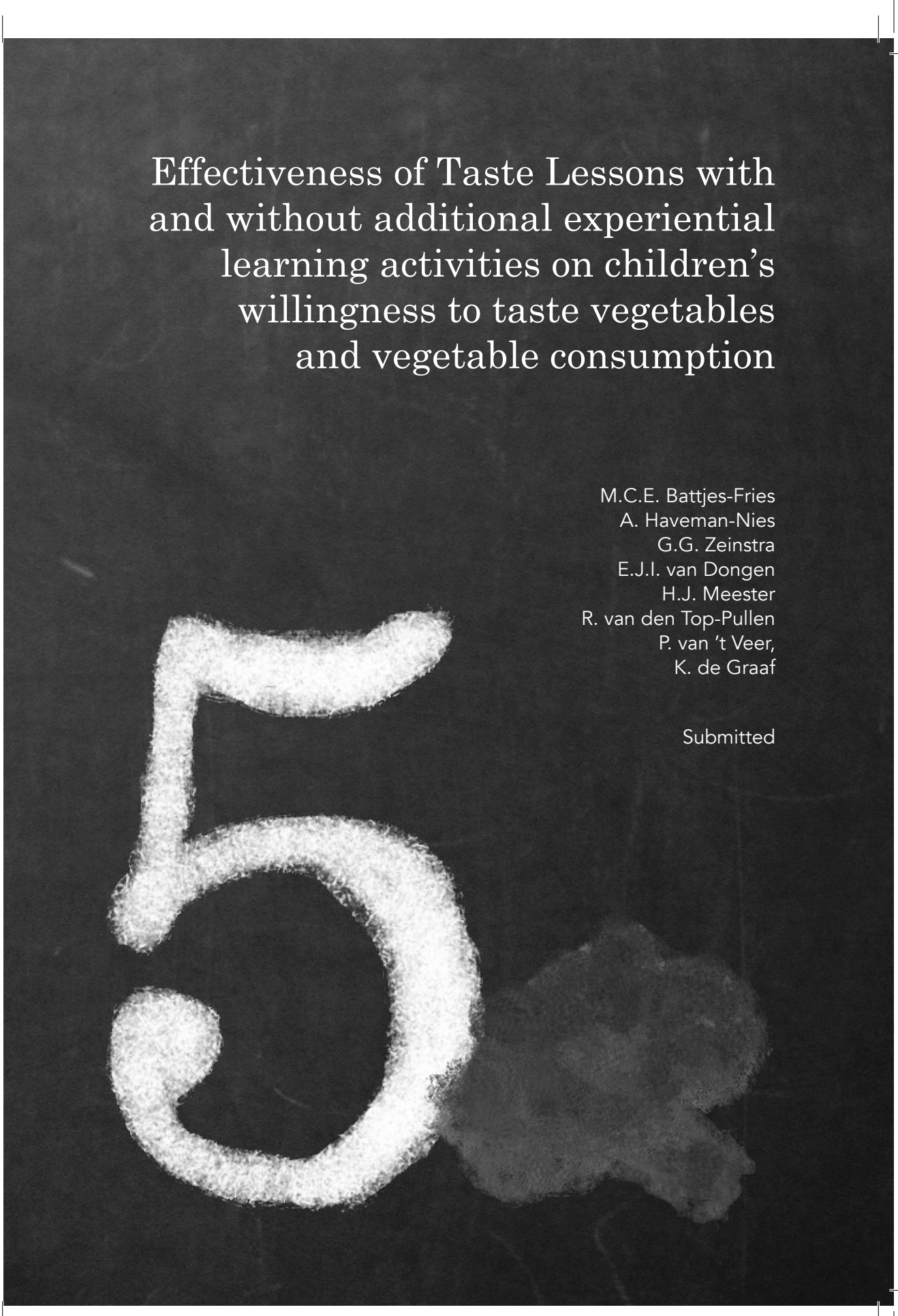

Abstract

Introduction

This study assessed the effectiveness of the Dutch school programme Taste Lessons with and without additional experiential learning activities on children's willingness to taste unfamiliar vegetables and vegetable consumption.

Methods

Thirty-three primary schools (877 children, 8–11 years old) participated in Taste Lessons Vegetable Menu (TLVM, lessons and extra activities), Taste Lessons (TL, lessons), or a control group. A baseline and follow-up measurement was used to assess for each child: number of four familiar and four unfamiliar vegetables tasted, quantity tasted, choice of vegetable of which to eat more, and number of vegetables willing to taste again later. Furthermore, children filled out a questionnaire on daily vegetable consumption and food neophobia. Multilevel and Cox regression analyses were conducted to compare changes in the outcome measures between the three study groups.

Results

No significant intervention effects were found on willingness to taste unfamiliar vegetables. Neither were effects found on familiar vegetables, except for number of familiar vegetables tasted (d=0.2, $p<0.05$). Furthermore, no significant intervention effects were found on daily vegetable consumption and food neophobia.

Conclusions

These results indicate that more intensive school-based nutrition education activities are needed to increase children's willingness to taste unfamiliar vegetables and increase their vegetable consumption.

Introduction

Vegetables are an essential part of a healthy eating pattern [1-3]. However, many children fail to eat enough vegetables, mainly because of low vegetable preference and food neophobia [3-6]). Several school-based programmes have tried to increase children's vegetable consumption, but have shown minimal effects [2, 5, 7-9].

Experiential learning methods, such as cooking, gardening, and tasting, are among the most promising strategies to enhance the effectiveness of such programmes [2, 8, 10, 11]. These methods may increase familiarity and create positive associations with vegetables [12, 13], resulting in increased vegetable preference, willingness to taste vegetables, and vegetable consumption [9, 13-15]. A systematic review showed that experiential learning methods are seldom applied in school-based nutrition education [7].

The Dutch school-based nutrition education programme 'Taste Lessons' makes use of experiential learning methods. The programme includes hands-on activities in each lesson, such as tasting, conducting experiments, and cooking. A former evaluation of Taste Lessons showed small effects on the self-reported number of familiar and unfamiliar food products tasted [16]. However, taste tests may provide a more objective estimation of willingness to taste vegetables than self-reports. Few studies have used objective measures to evaluate whether school-based nutrition education programmes using experiential learning methods have an effect on willingness to taste vegetables. Evaluation studies of sensory education in other European countries (known as the SAPERE method) used taste tests in a school setting and showed significant increases in willingness to try unfamiliar foods in France [17], but not in Finland [18]. Of three other studies that evaluated school-based nutrition education programmes including gardening and cooking activities with taste tests, two found significant increases in willingness to taste vegetables [19, 20], and one did not [21].

It is therefore unclear whether experiential learning methods enhance children's willingness to taste vegetables. The purpose of the current study was to use objective and subjective measures in the school setting to assess the effectiveness of Taste Lessons with and without additional experiential learning activities on children's willingness to taste vegetables and vegetable consumption.

Methods

Intervention design

Taste Lessons (Smaaklessen) is a national, school-based nutrition education programme for grades 1–8 of primary schools (children aged 4–12 years), developed in 2006 by the Netherlands Nutrition Centre and Wageningen University. The programme consists of five lessons per grade on the themes taste development, healthy eating, food production, consumer skills, and cooking. Each lesson takes on average 45 minutes and includes plenary group talks and in-class hands-on activities. In 2013, a format was developed that extends Taste Lessons with additional hands-on activities for the five basic food groups. For this study, the Taste Lessons Vegetable Menu for 6th and 7th graders (10–11 year-olds) was developed, consisting of the five existing lessons (teaching materials for the two grades combined and tailored to the food group vegetables) and four additional hands-on activities: a vegetable quiz, an excursion to a vegetable grower, a home assignment for the children to perform with their parents in the supermarket, and a cooking lesson with a dietician and the parents (extended version of lesson 5 of Taste Lessons). The programme was implemented by the teachers themselves, after attending an introductory workshop in which the programme was explained. To take pressure off the teachers, the excursion and cooking lesson were arranged for the schools by the research team.

Study design and procedure

A quasi-experimental design with three arms was used to assess the effect of the Taste Lessons Vegetable Menu. The study was conducted among 1010 children in 34 primary schools. Of this group, 11 schools implemented the Taste Lessons Vegetable Menu (TLVM), 11 schools implemented Taste Lessons (TL), and 12 schools took part in the study as a control group. In February–April 2013, the intervention schools were visited the week before and after the intervention for the baseline and the follow-up measurement, respectively. The measurements in the control schools took place in the same period. Children took part in the study whose parents reported no refusal to participate. Under supervision of a research assistant, children completed a questionnaire in class and an individual taste test in a separate room. Prior to the intervention study, children received a questionnaire to take home for completion by one of their parents (on paper or online). Teachers completed a questionnaire before the study started.

Study population

The study took place in the Dutch province of Gelderland. Schools in this region were invited to participate in a randomly allocated study group. Schools were

included if they were not planning to participate in any other nutrition-related education programme and the children in grades 6–7 had not been previously enrolled in Taste Lessons. Of the 219 schools approached, 34 schools were willing to participate (16%). Eleven schools (417 children in 18 classes) participated in the TLVM group, eleven schools (285 children in 13 classes) in the TL group, and twelve schools (308 children in 18 classes) in the control group. All recruited classes participated in the baseline measurement. Of the 1,010 children in total, 948 children completed the baseline questionnaire (94%) and 944 children the taste tests (93%). At the follow-up measurement, all but one class in the control group completed the questionnaire (885 children, 88%), and all but one class in the TL group participated in the taste tests (912 children, 90%). In total, 877 children (87%) participated in both taste tests and 828 children (82%) filled out both questionnaires.

Measures

Willingness to taste vegetables

Children's willingness to taste vegetables was assessed by conducting different tasks in a taste test in which children received both four unfamiliar and four familiar vegetables. The eight vegetables were selected on the basis of consumption data from the Dutch food consumption survey [22], seasonal availability, and the possibility of being eaten raw. The vegetables were grouped into two pairs of generally unfamiliar vegetables (turnip cabbage and white radish; fennel and romanesco) and two pairs of generally familiar vegetables (tomatoes and cucumber; carrots and bell pepper). Children were given one vegetable from each pair at the baseline test and the other vegetable at the follow-up test in random order. Questions posed to the children at the end of the taste test confirmed that the selected unfamiliar vegetables were indeed unfamiliar; 0–5% of the children recognised these vegetables. The selected familiar vegetables were familiar to almost all children; 90–100% of the children recognised these vegetables. A portion of approximately 50 grams of the four vegetables was served raw, chopped into bite-sized pieces, and presented to the children in plastic cups together with a photograph of the whole vegetable.

With the test, willingness to taste was both implicitly and explicitly assessed. For the implicit measure, children were asked to rank the two familiar and the two unfamiliar vegetables on liking, crunchiness, sweetness, and strongest flavour. The children were instructed to taste the provided vegetables as frequently as they wanted and in the quantity that they wanted. The cups were weighed before and after the test to determine whether consumption had taken place and how much was consumed of each vegetable. Outcome measures were number of vegetables tasted (yes or no per vegetable and 0–2 familiar/

unfamiliar vegetables in total), quantity of vegetables consumed (0–50 grams per vegetable and 0–100 grams of the familiar/unfamiliar vegetables in total). As a more explicit measure, a new batch of four cups with 50 grams of the same vegetables was presented, and the children were given the opportunity to choose one vegetable of which to eat more. While the children were eating their chosen vegetable, they were asked questions on their familiarity with the four vegetables and whether they were willing to taste them again later (yes, maybe, no). Outcome measures were choice of vegetable (unfamiliar or familiar vegetable) and number of vegetables willing to taste again later (yes versus maybe and no per vegetable and 0–2 of the familiar/unfamiliar vegetables in total).

Vegetable consumption and food neophobia

Children were asked to report their daily vegetable consumption by replying to the questions 'On how many days do you eat vegetables' (0–7 days per week), and 'On these days, what quantity of vegetables do you eat at supper' (1=less than one to 4=more than four serving spoons). In addition, the child was asked how many days he/she ate vegetables besides at supper (0=almost never to 3=almost every day).

Food neophobia was assessed with the six-item version of the Child Food Neophobia Scale [23, 24] reformulated into questions to be filled out by the children themselves. The six items were: 'I often try to taste foods I never ate before' (reverse score), 'I don't trust foods I don't know', 'If I don't know what's in a food, I won't try it', 'I'm afraid to eat foods I never had before', 'I'm very picky about foods', and 'I eat almost everything' (reverse score). Answers were given on a five-point Likert scale ranging from 1 (strongly disagree) – 5 (strongly agree). The mean score was used in the analyses. Higher scores indicate higher neophobia. Cronbach's α for the six-item version was 0.66.

Socio-demographic factors

The children's questionnaire included questions on date of birth and sex. The parents' baseline questionnaire included questions on the child's and the parents' ethnicity (country of birth), the child's height and weight, and the parents' educational level (low, middle, high) and marital status (married, cohabiting, unmarried, divorced, widowed). The mothers' information on their educational level and marital status was used in the analyses. Children were classified as non-Dutch if they or one of their parents were born outside the Netherlands. BMI was calculated by dividing the child's body weight (in kilograms) by height (in metres) squared. Their weight status was classified into normal weight and overweight using the IOTF standard definitions [25]. Information on school

characteristics was obtained from the online database of Dutch primary schools [26]. The database includes location (town (<10,000 inhabitants), semi-city (10,000–100,000 inhabitants), or city >100,000 inhabitants), religious principle (public or religious), and school size (small (<150 pupils), medium (150–400 pupils), or large (>400 pupils)). The teachers' baseline questionnaire included questions on sex, age, and years of teaching experience. These socio-demographic factors were considered as potential confounders and effect modifiers in the analyses.

Statistical analyses

SPSS (version 20.0) was used for the descriptive analyses. First, the TLVM, the TL, and the control groups were compared on their socio-demographic characteristics by use of Chi-square and one-way ANOVA. Second, independent t-tests were used to compare the scores on the outcome measures at baseline and follow-up within each study group.

Subsequently, change scores were calculated as the difference in score between the baseline and the follow-up measurement [27]. Multilevel analyses were performed with the HLM programme (version 7) to evaluate changes in the outcome measures between the three study groups on three levels: (1) pupil, (2) class, and (3) school. Multivariate linear regression analyses were performed, with each change score as the dependent variable and dummy variables for the study groups as explanatory variables, adjusted for children's age and sex. When other socio-demographic factors were added to the model one by one as potential confounders and effect modifiers, they were not found to materially affect the effect estimates. Relative effect sizes were calculated as Cohen's *d* [28]: the regression coefficient of the intervention condition (adjusted difference in change score between the intervention and the control group) divided by the total standard deviation over all three levels of the adjusted model.

For the choice of vegetable of which to eat more, an odds ratio was calculated for each study group as number of children changing from a familiar vegetable at baseline to an unfamiliar vegetable at follow-up divided by the number of children changing vice versa. Cox regression analyses were performed in SPSS to test difference in the odds ratios between the three study groups. Results were interpreted as significant at $p<0.05$.

Results

Characteristics of the study population

All the study groups included mainly normal-weight children of Dutch origin, with a mean age of 10 years (Table 1). Mothers of children in the TLVM group were on average somewhat younger, had more children, more often breastfed their child, and were somewhat less educated than those in the TL and the control group. Compared with the TL and the control group, the TLVM group included relatively more large schools, more schools with a religious principle, and teachers who were somewhat older and more experienced in teaching.

Table 1. Socio-demographic characteristics of the children, mothers, teachers and schools.

	TLVM		TL		Control	
	N	% / Mean (SD)	N	% / Mean (SD)	N	% / Mean (SD)
Children (n=877)						
Age (in years)	364	10.3 (0.7)	236	10.3 (0.7)	277	10.4 (0.7)
Sex						
- Boy	177	48	112	48	144	52
- Girl	187	52	124	52	133	48
Ethnicity[1]						
- Dutch	213	90	109	92	142	92
- Non-Dutch	25	10	10	8	13	8
Weight status[1]						
- Normal weight	183	92	89	84	114	91
- Overweight	17	8	17	16	11	9
Breast fed[1*]						
- Yes	206	80	86	67	124	73
- No	53	20	42	33	45	27
Mothers (n=558)						
Age (in years)[2*]	224	40.6 (4.2)	112	42.0 (3.6)	122	41.4 (3.9)
Number of children[2*]	260	2.8 (1.3)	128	2.3 (0.7)	168	2.3 (0.7)
Marital status2						
- Married/cohabiting	242	93	122	88	150	89
- Unmarried/divorced/widowed	20	7	16	12	18	11
Educational level[2]						
- Low	41	18	12	11	12	10
- Middle	116	51	56	51	65	54
- High	70	31	42	38	44	36

Table 1. (Continued).

	TLVM		TL		Control	
	N	% / Mean (SD)	N	% / Mean (SD)	N	% / Mean (SD)
Teachers (n=46)						
Age (in years)[3]	16	42.9 (13.5)	12	39.6 (10.9)	17	38.1 (10.8)
Teaching experience (in years)	16	18.3 (13.0)	12	16.0 (11.5)	18	11.8 (9.8)
Sex						
- Male	3	19	1	8	2	11
- High	13	81	11	92	16	89
Schools (n=33)						
Religious principle						
- Public	3	27	4	40	6	50
- Religious	8	73	6	60	6	50
Size*						
- Small	2	18	7	70	9	75
- Medium	5	46	2	20	3	25
- Large	4	36	1	10	0	0
Location						
- Town	3	27	4	40	6	50
- Small city	7	64	4	40	2	17
- City	1	9	2	20	4	33

[1] Assessed by questions on the parents' questionnaire, with N=521, 431, 556, respectively. [2] N ranging from 458–558. [3] Age of one teacher unknown. * Significant difference between the three study groups ($p<0.05$).

Willingness to taste the familiar and the unfamiliar vegetables at baseline

At baseline, the familiar and the unfamiliar vegetables were tasted by about 70% and 75% of the children, respectively (Table 2). If the children were willing to taste a vegetable, they consumed on average five grams of it. About 85% chose a familiar vegetable of which to eat more, and about 60% and 40% of the children were willing to taste the familiar and the unfamiliar vegetable again later, respectively. There were no significant differences in these outcome measures at baseline between the study groups.

Table 2. Number of children who tasted the unfamiliar and the familiar vegetables, chose the vegetable of which to eat more, and was willing to taste the vegetables again later, and consumption of the vegetables when tasted.

	Tasted the vegetable			Quantity of vegetable tasted			Chose the vegetable of which to eat more			Willing to taste the vegetable again		
	Baseline	Follow-up	Change	Baseline	Follow-up	Change	Baseline	Follow-up	Change	Baseline	Follow-up	Change
	%	%	%	Mean (SD)	Mean (SD)	Mean	%	%	%	%	%	%
Unfamiliar vegetables												
White radish												
- TLVM	78	75	-3	6 (4)	6 (5)	0	7	8	1	43	51	8
- TL	84	79	-5	5 (3)	7 (4)	2	3	7	4	38	44	6
- Control	78	66	-12	6 (5)	6 (5)	0	3	4	1	46	44	-2
Turnip cabbage												
- TLVM	80	78	-2	6 (4)	5 (4)	-1	5	12	7	48	53	5
- TL	79	78	-1	7 (5)	5 (4)	-2	9	7	-2	47	52	5
- Control	74	72	-2	6 (4)	6 (5)	0	4	10	6	44	49	5
Romanesco												
- TLVM	70	73	3	6 (4)	5 (5)	0	2	1	-1	33	28	-5
- TL	74	79	5	6 (5)	5 (4)	-1	2	2	0	44	38	-6
- Control	68	72	4	6 (5)	6 (5)	-1	2	3	1	37	37	0
Fennel												
- TLVM	76	71	-5	3 (3)	3 (2)	0	1	3	2	32	40	8
- TL	82	74	-8	3 (2)	3 (3)	0	0	3	3	36	38	2
- Control	76	68	-8	4 (4)	4 (3)	0	3	4	1	40	47	7

Table 2. (Continued).

	Tasted the vegetable			Quantity of vegetable tasted			Chose the vegetable of which to eat more			Willing to taste the vegetable again		
	Baseline	Follow-up	Change	Baseline	Follow-up	Change	Baseline	Follow-up	Change	Baseline	Follow-up	Change
	%	%	%	Mean (SD)	Mean (SD)	Mean	%	%	%	%	%	%
Familiar vegetables												
Cucumber												
- TLVM	74	81	7	7 (6)	6 (5)	-1	28	30	2	65	70	5
- TL	77	77	0	6 (3)	6 (5)	0	28	27	-1	67	69	2
- Control	71	68	-3	7 (6)	6 (4)	-1	27	33	6	75	74	-1
Tomato												
- TLVM	64	59	-5	10 (9)	9 (6)	-1	20	15	-5	53	45	-8
- TL	63	59	-4	10 (8)	9 (6)	-1	17	14	-3	55	37	-18
- Control	63	51	-12	10 (8)	9 (7)	-1	18	14	-4	52	46	-6
Carrot												
- TLVM	67	75	8	5 (4)	6 (4)	0	20	17	-3	65	68	3
- TL	71	74	3	6 (5)	6 (5)	0	22	14	-8	68	56	-12
- Control	73	67	-6	7 (5)	7 (5)	0	21	18	-3	65	69	4
Bell pepper												
- TLVM	65	62	-3	4 (4)	3 (2)	-1	18	14	-4	58	55	-3
- TL	66	72	6	5 (3)	4 (4)	-1	18	25	7	62	55	-7
- Control	74	58	-16	4 (3)	4 (3)	-1	20	15	-5	60	54	-6

Table 3. Means and effect sizes for each outcome measure[1]

	Mean			Effect size	
	Baseline Mean (SD)	Follow-up Mean (SD)	Change Mean (SD)	TLVM / TL–Control Cohen's d (95% CI)	TLVM–TL Cohen's d (95% CI)
Number of vegetables tasted					
Unfamiliar vegetables					
- TLVM	1.5 (0.8)	1.5 (0.8)	0.0 (0.7)	0.1 (-0.1 - 0.2)	0.0 (-0.2 - 0.2)
- TL	1.6 (0.7)	1.6 (0.8)	-0.1 (0.8)	0.1 (-0.1 - 0.2)	
- Control	1.5 (0.8)	1.4 (0.9)	-0.1 (0.8)		
Familiar vegetables					
- TLVM	1.4 (0.8)	1.4 (0.8)	0.1 (0.8)	0.2 (0.1 - 0.4)**	0.0 (-0.2 - 0.2)
- TL	1.4 (0.8)	1.4 (0.8)	0.0 (0.9)	0.2 (0.0 - 0.4)*	
- Control	1.4 (0.8)	1.2 (0.9)	-0.2 (0.9)**		
Quantity of vegetables consumed when tasted					
Unfamiliar vegetables					
- TLVM	9.5 (6.7)	8.9 (7.1)	-0.6 (7.2)	-0.1 (-0.3 - 0.1)	0.0 (-0.3 - 0.2)
- TL	9.3 (6.8)	9.2 (6.5)	-0.4 (6.1)	0.0 (-0.3 - 0.2)	
- Control	10.1 (8.4)	10.2 (7.8)	-0.1 (6.8)		
Familiar vegetables					
- TLVM	11.4 (9.8)	10.3 (7.6)	-1.4 (11.0)*	0.0 (-0.2 - 0.2)	0.0 (-0.2 - 0.2)
- TL	11.7 (9.1)	10.5 (8.4)	-1.3 (9.9)	0.0 (-0.2 - 0.3)	
- Control	12.1 (9.9)	11.2 (8.5)	-1.7 (9.8)*		
Number of vegetables willing to taste again later					
Unfamiliar vegetables					
- TLVM	0.8 (0.8)	0.9 (0.8)	0.1 (0.8)*	0.0 (-0.1 - 0.2)	0.1 (-0.1 - 0.2)
- TL	0.8 (0.8)	0.9 (0.8)	0.0 (0.8)	0.0 (-0.2 - 0.1)	
- Control	0.8 (0.8)	0.9 (0.8)	0.1 (0.8)		
Familiar vegetables					
- TLVM	1.2 (0.8)	1.2 (0.8)	0.0 (0.9)	0.0 (-0.1 - 0.2)	0.2 (0.0 - 0.3)
- TL	1.3 (0.8)	1.1 (0.8)	-0.2 (0.9)*	-0.1 (-0.3 - 0.0)	
- Control	1.3 (0.7)	1.2 (0.8)	0.0 (0.9)		

[1] Effect sizes are adjusted for children's age and sex. N=877. * p<0.05, ** p<0.01, *** p<0.001

Table 3. (Continued)

	Mean			Effect size	
	Baseline Mean (SD)	Follow-up Mean (SD)	Change Mean (SD)	TLVM / TL–Control Cohen's *d* (95% CI)	TLVM–TL Cohen's *d* (95% CI)
Daily vegetable consumption					
Number of days per week at supper					
- TLVM	6.4 (1.5)	6.6 (1.4)	0.1 (1.2)	0.0 (-0.2 - 0.2)	0.1 (-0.2 - 0.3)
- TL	6.5 (1.6)	6.5 (1.4)	0.0 (1.2)	-0.1 (-0.2 - 0.1)	
- Control	6.2 (1.6)	6.3 (1.6)	0.1 (1.3)		
Number of serving spoons at supper					
- TLVM	2.5 (0.7)	2.4 (0.6)	-0.1 (0.6)*	-0.1 (-0.2 - 0.1)	-0.1 (-0.3 - 0.1)
- TL	2.4 (0.6)	2.4 (0.6)	0.0 (0.6)	0.1 (-0.1 - 0.3)	
- Control	2.4 (0.6)	2.3 (0.6)	-0.1 (0.6)		
Number of days per week as snack					
- TLVM	2.0 (0.9)	2.1 (0.9)	0.1 (0.9)	-0.1 (-0.3 - 0.1)	0.0 (-0.2 - 0.2)
- TL	2.0 (0.9)	2.0 (0.8)	0.1 (0.9)	-0.1 (-0.3 - 0.1)	
- Control	1.9 (0.9)	2.1 (0.9)	0.2 (0.9)**		
Food neophobia					
- TLVM	13.8 (3.8)	13.6 (4.4)	-0.2 (3.1)	0.1 (-0.1 - 0.2)	0.1 (-0.1 - 0.2)
- TL	13.8 (4.2)	13.2 (4.8)	-0.4 (3.5)	0.0 (-0.2 - 0.2)	
- Control	14.4 (4.2)	13.9 (4.4)	-0.5 (3.6)*		

[1] Effect sizes are adjusted for children's age and sex. N=877. * p<0.05, ** p<0.01, *** p<0.001

Effect of TLVM and TL on willingness to taste the vegetables

The TLVM and the TL group did not significantly change in number of familiar and unfamiliar vegetables tasted (Tables 2 and 3). In contrast, the control group decreased in number of children who tasted white radish, tomato, and bell pepper, resulting in a significant positive effect for the TLVM and the TL group on number of familiar vegetables tasted compared to the control group (d=0.2, p<0.05).

Almost no changes were observed in the quantity of unfamiliar vegetables tasted in all three study groups. With regard to the familiar foods, children in the TLVM and the control group significantly decreased their consumption during the taste test (both p<0.05; Tables 2 and 3), but no significant differences were found between the study groups.

About 20% of the children in the TLVM and the control group ($p<0.001$ and $p<0.05$, respectively) and 12% in the TL group (ns) changed from the choice of a familiar vegetable at baseline to the choice of an unfamiliar vegetable at follow-up (Table 4). This was mainly due to an increase in choice of turnip cabbage (Table 2). No significant differences were found between the study groups.

The TLVM group significantly increased in number of unfamiliar vegetables willing to taste again later ($p<0.05$), mainly due to small increases in white radish and fennel, but remained stable with regard to the familiar vegetables (Tables 2 and 3). In contrast, the TL group significantly decreased in number of familiar vegetables willing to taste again later ($p<0.05$), mainly resulting from decreases in tomato and carrot, but remained regarding unfamiliar vegetables. However, no significant differences between the study groups were found.

Daily vegetable consumption and food neophobia

At baseline, children reported eating vegetables on average 5–6 days per week with 2–3 serving spoons at supper, and reported sometimes eating vegetables at times other than supper (Table 3). Although the TLVM group significantly decreased in portion size at supper ($p<0.05$) and the control group significantly increased in frequency of eating vegetables besides at supper ($p<0.01$), no changes were significantly different between the study groups. Furthermore, all study groups slightly decreased in food neophobia score; this was significant only in the control group ($p<0.05$), but not significantly different from the TLVM and the TL group.

Table 3. Change in choice of unfamiliar or familiar vegetable of which to eat more

	Follow-up		*Odds ratio*[1]
	Unfamiliar vegetable	Familiar vegetable	
	N	N	
Baseline			
TLVM			
Unfamiliar vegetable	18	25	2.1
Familiar vegetable	53	189	
TL			
Unfamiliar vegetable	13	14	1.6
Familiar vegetable	23	142	
Control			
Unfamiliar vegetable	9	22	1.8
Familiar vegetable	39	142	

[1] Number of children changing from a familiar vegetable at baseline to an unfamiliar vegetable at follow-up divided by the number of children changing from an unfamiliar vegetable at baseline to a familiar vegetable at follow-up.

Discussion

The aim of this study was to assess the effect of Taste Lessons with and without extra experiential learning activities on children's willingness to taste unfamiliar vegetables and vegetable consumption. The results showed a positive effect on number of familiar vegetables tasted for both intervention groups compared to the control group, but no significant intervention effects were found with regard to the unfamiliar vegetables. The TLVM group showed an increase in the number of children who chose an unfamiliar vegetable of which to eat more and in the number of children willing to taste the unfamiliar vegetables again later, but these increases were not significantly higher compared to the control group. No significant intervention effects were found on children's daily vegetable consumption and food neophobia.

In this study, a taste test including several tasks was used to objectively assess different aspects of children's willingness to taste vegetables. However, conducting the taste test had some limitations. The taste test was performed outside the classroom with one child and one research team member each time. Although a protocol was used, differences existed between research members and test locations in the schools. These differences might have influenced children's willingness to taste the vegetables during the taste test. However, as change in willingness to taste the vegetables was used as the outcome measure, it is not likely that these differences had a major influence on the results of this study.

Daily vegetable consumption and food neophobia were measured using a questionnaire which the children filled out themselves. Children's cognitive capabilities might have resulted in biased estimations of their vegetable consumption. Tak et al. [29] have suggested that parents' self-reports on their child's daily vegetable consumption provide more valid results than children's self-reports. However, child reports on vegetable consumption showed to be significantly correlated to parental reports in a sub-sample of our study (results not shown); this indicates reliable estimations. Providing limited answer categories to keep the questionnaire simple may, however, have resulted in too little sensitivity to observe small changes in frequency or portion size of daily vegetable consumption.

Schools were recruited for this study by inviting them to a randomly allocated study group. As nutrition education is not mandatory in Dutch primary schools and the Taste Lessons Vegetable Menu takes approximately eight hours to implement, only a selective group of enthusiastic and highly motivated teachers may have been willing to implement the programme [9]. This may have been

the cause of the lower percentage of schools willing to participate in this group (10% versus 20% in the other two study groups) and consequently may have caused small differences in parent, teacher, and school characteristics between this and the two other study groups. However, the children showed almost no differences in the outcome measures at baseline, and no significant confounders were found. Therefore, selection bias is not likely to have influenced the results of this study.

The results of this study showed a positive effect for both intervention groups compared to the control group on the number of familiar vegetables tasted. This effect can be mainly attributed to a significant decrease in number of familiar vegetables tasted in the control group. A reason for this decrease might be a testing effect: the children in the control group might got bored of participating in a similar taste test at the follow-up measurement as at the baseline measurement in a short period of time [30, 31]. In contrast, the intervention group did not show a significant decrease in the number of familiar vegetables tasted. Also Hendy et al. [32] observed that a high acceptance of foods when these were first presented, disappeared after repeated presentation of these foods in the control group, whereas in the intervention group enthusiastic teacher modelling maintained children's new food acceptance. The intervention effect might therefore indicate that Taste Lessons kept the children enthusiastic about tasting vegetables at the follow-up measurement.

Although children in the TLVM group showed an increase in choice of an unfamiliar vegetable of which to eat more and number of unfamiliar vegetables willing to taste again later, no significant intervention effects were observed for these and the other aspects of children's willingness to taste unfamiliar vegetables. Possibly, the intervention was not intensive enough to induce clear intervention effects. Evaluation of a more intensive Scottish nine-month programme including provision of fruit and vegetables and related activities [20], an Australian ten-week vegetable programme including gardening activities [19], and a French version of Taste Lessons with twelve sensory education lessons [17] found higher significant increases in number of vegetables tasted compared to the control group. Evaluation of the less intensive Finnish version of Taste Lessons with ten lessons [18] and an American nutrition curriculum of nine lessons and garden-activities [21] did not. More research is needed to explore whether there is a threshold of number of lessons or activities required in order to have an effect on children's willingness to taste unfamiliar vegetables.

In this study, no intervention effects were found on food neophobia. Children's willingness to taste unfamiliar foods can be seen as behavioural food neophobia, and children's food neophobia score more as a trait [33]. Trait food neophobia might be even harder to change than behavioural food neophobia, expressed as

children's willingness to taste unfamiliar vegetables. Since no clear intervention effects were found on willingness to taste unfamiliar vegetables, it is therefore plausible that no effect on food neophobia was found.

Finally, no intervention effects were observed with regard to children's vegetable consumption. Several reviews have already reported that the impact of nutrition education programmes on increasing children's vegetable consumption is minimal [2, 7, 34]. The literature suggests that experiential learning methods might enhance the effect of such programmes [2, 11], but that a minimum of twelve months on follow-up with prolonged exposure to vegetables is required to achieve a substantial effect [2, 35]. Although TLVM is more intensive and includes even more experiential learning methods than TL, the amount of exposure to TLVM is far lower than the suggested minimum of twelve months. As described above, this suggests that a more intensive exposure to nutrition education is needed to increase children's vegetable consumption. Furthermore, vegetable consumption remains majorly controlled by the availability of vegetables and parental eating practices at home. Contento et al. have raised the question of whether school-based nutrition education should target behavioural changes at all, because many factors outside the school influence children's eating behaviour [34]. Perhaps only an effect on proxy outcomes, such as increasing knowledge and other psychosocial determinants of vegetable consumption, can be expected, especially in school systems such as that of the Netherlands where primary schools generally do not provide meals [16, 20].

Conclusions

Implementation of Taste Lessons with and without extra experiential learning activities did not show significant effects on children's willingness to taste unfamiliar vegetables, vegetable consumption, or food neophobia. For the difficult task of increasing children's vegetable consumption, a more intensive programme and broader approach might be needed.

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References

1. WHO. Diet, Nutrition and the prevention of chronic diseases. Report of a Joint WHO/ FAO Expert consultation. Geneva: 2003 916.
2. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: A systematic review. Preventive Medicine. 2006;42(2):85-95.
3. Beck J, De Witt P, McNally J, Siegfried S, Hill JO, Stroebele-Benschop N. Predictors of meeting physical activity and fruit and vegetable recommendations in 9–11-year-old children. Health Education Journal. 2015;74(2):183-196.
4. Birch LL. Preschool children's food preferences and consumption patterns. Journal of Nutrition Education. 1979;11(4):189-92.
5. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. Journal of Human Nutrition and Dietetics. 2005;18(6):431-43.
6. De Bourdeaudhuij I, Klepp KI, Due P, Rodrigo CP, de Almeida M, Wind M, et al. Reliability and validity of a questionnaire to measure personal, social and environmental correlates of fruit and vegetable intake in 10-11-year-old children in five European countries. Public Health Nutrition. 2005;8(2):189-200.
7. Evans CE, Christian MS, Cleghorn CL, Greenwood DC, Cade JE. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. The American Journal of Clinical Nutrition. 2012;96(4):889-901.
8. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1A):131-9.
9. Hersch D, Perdue L, Ambroz T, Boucher JL. The Impact of Cooking Classes on Food-Related Preferences, Attitudes, and Behaviors of School-Aged Children: A Systematic Review of the Evidence, 2003–2014. Preventing Chronic Disease. 2014;11:E193.
10. Peters LWH, Kok G, Ten Dam GTM, Buijs GJ, Paulussen TGWM. Effective elements of school health promotion across behavioral domains: a systematic review of reviews. BMC Public Health. 2009;9:182.
11. Dudley D, Cotton W, Peralta L. Teaching approaches and strategies that promote healthy eating in primary school children: a systematic review and meta-analysis. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):28.
12. van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. Appetite. 2014;79(0):18-24.
13. Heim S, Stang J, Ireland M. A Garden Pilot Project Enhances Fruit and Vegetable Consumption among Children. Journal of the American Dietetic Association. 2009;109(7):1220-6.
14. Dazeley P, Houston-Price C, Hill C. Should healthy eating programmes incorporate interaction with foods in different sensory modalities? A review of the evidence. British Journal of Nutrition. 2012;108(05):769-77.
15. Robinson-O'Brien R, Story M, Heim S. Impact of Garden-Based Youth Nutrition Intervention Programs: A Review. Journal of the American Dietetic Association. 2009;109(2):273-80.
16. Battjes-Fries MC, Haveman-Nies A, Renes R-J, Meester HJ, van 't Veer P. Effect of the Dutch school-based education programme 'Taste Lessons' on behavioural determinants of taste acceptance and healthy eating: a quasi-experimental study. Public Health Nutrition. 2015;18(12):2231-41.
17. Reverdy C, Chesnel F, Schlich P, Köster EP, Lange C. Effect of sensory education on willingness to taste novel food in children. Appetite. 2008;51(1):156-65.
18. Mustonen S, Rantanen R, Tuorila H. Effect of sensory education on school children's food perception: A 2-year follow-up study. Food Quality and Preference. 2009;20(3):230-40.
19. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. Public Health Nutrition. 2010;13(11):1931-40.
20. Anderson A, Porteous L, Foster E, Higgins C, Stead M, Hetherington M, et al. The impact of a school-based nutrition education intervention on dietary intake and cognitive and attitudinal variables relating to fruits and vegetables. Public Health Nutrition. 2005;8(06):650-6.

21. Morris JL, Zidenberg-Cherr S. Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. Journal of the American Dietetic Association. 2002;102(1):91-3.
22. RIVM. Dutch National Food Consumption Survey 2007-2010, Part 2 Total Foods, Version 2, based on dataset FCS_2010_core_201111252012 August 2013. Available from: http://www.rivm.nl.
23. Pliner P. Development of Measures of Food Neophobia in Children. Appetite. 1994;23(2):147-63.
24. Wardle J, Carnell S, Cooke L. Parental control over feeding and children's fruit and vegetable intake: How are they related? Journal of the American Dietetic Association. 2005;105(2):227-32.
25. Cole TJ, Bellizzi MC, Flegal KM, Dietz WH. Establishing a standard definition for child overweight and obesity worldwide: international survey. BMJ. 2000;320.7244:1240.
26. Onderwijsdata - primair onderwijs: Dienst Uitvoering Onderwijs - Ministerie van Onderwijs, Cultuur en Wetenschap. Cited: December 2012. Available from: www.duo.nl.
27. Van Breukelen GJP. ANCOVA versus change from baseline had more power in randomized studies and more bias in nonrandomized studies. Journal of Clinical Epidemiology. 2006;59(9):920-5.
28. Cohen J. A power primer. Psychol Bull. 1992;112(1):155-9.
29. Tak N, te Velde S, Brug J. Are positive changes in potential determinants associated with increased fruit and vegetable intakes among primary schoolchildren? Results of two intervention studies in the Netherlands: The Schoolgruiten Project and the Pro Children Study. International Journal of Behavioral Nutrition and Physical Activity. 2008;5(1):21.
30. Laureati M, Bergamaschi V, Pagliarini E. School-based intervention with children. Peer-modeling, reward and repeated exposure reduce food neophobia and increase liking of fruits and vegetables. Appetite. 2014;83(0):26-32.
31. Mela DJ. Why do we like what we like? J Sci Food Agric. 2001;81(1):10-16.
32. Hendy HM, Raudenbush B. Effectiveness of teacher modeling to encourage food acceptance in preschool children. Appetite. 2000;34(1):61-76.
33. Mustonen S, Oerlemans P, Tuorila H. Familiarity with and affective responses to foods in 8–11-year-old children. The role of food neophobia and parental education. Appetite. 2012;58(3):777-80.
34. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
35. Jaenke RL, Collins CE, Morgan PJ, Lubans DR, Saunders KL, Warren JM. The Impact of a School Garden and Cooking Program on Boys' and Girls' Fruit and Vegetable Preferences, Taste Rating, and Intake. Health Education & Behavior. 2012;39(2):131-41

5

Associations between school-, teacher-, parent-, and child- related implementation factors and effectiveness of the Dutch school-based nutrition education programme Taste Lessons

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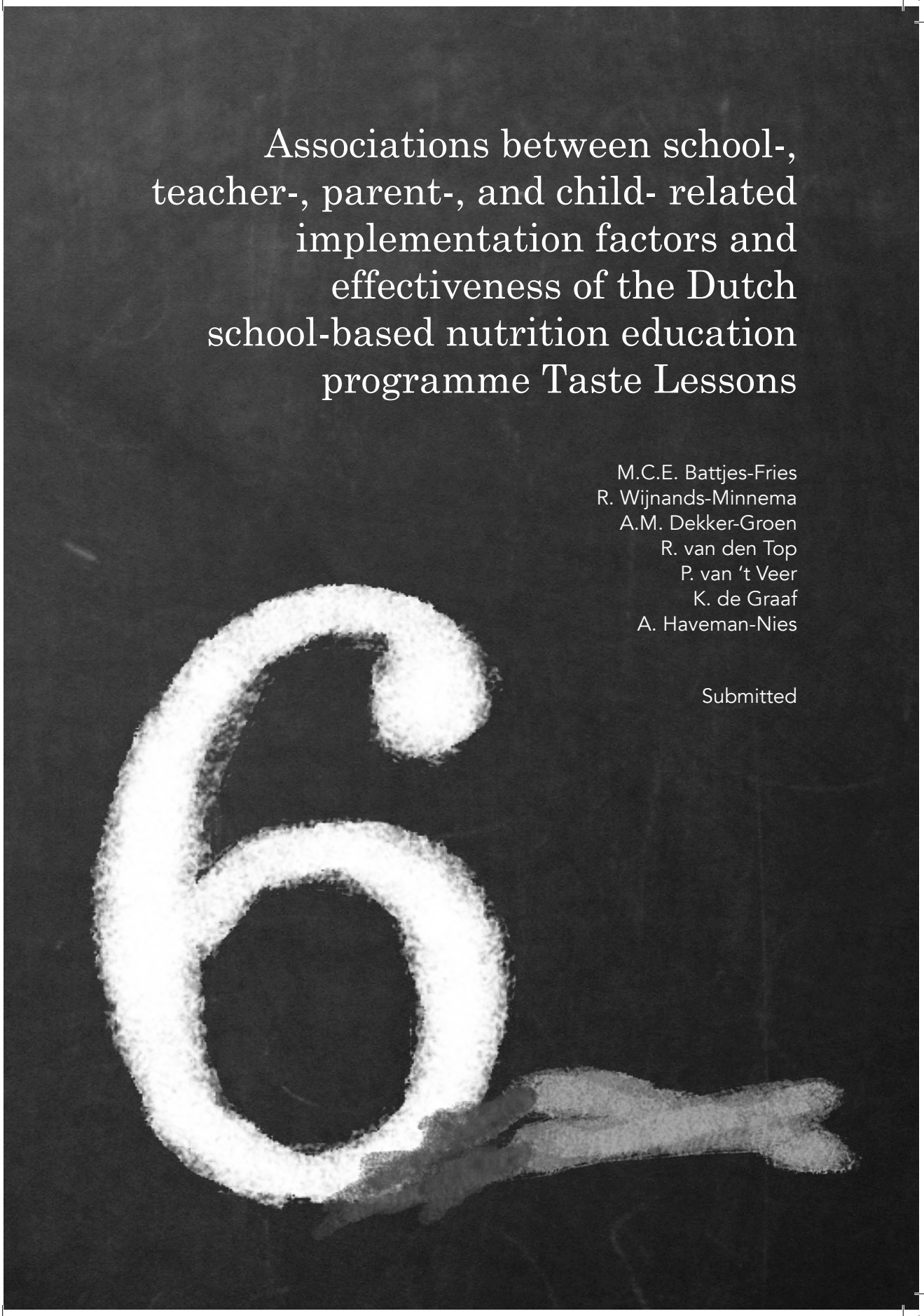

Abstract

Objective

To investigate the association between school-, teacher-, parent-, and child-related factors and children's psychosocial determinants of vegetable consumption before and during the implementation of the Dutch school-based nutrition education programme Taste Lessons.

Methods

In a quasi-experimental design, 800 children (8–11 years old) in 48 classes of 34 primary schools participated in a Taste Lessons (TL) group, a Taste Lessons Vegetable Menu (TLVM: an extended format of TL) group, and a control group. At baseline and follow-up measurement, children completed a questionnaire on their psychosocial determinants of vegetable consumption. In addition, children, parents, and teachers completed a questionnaire in which implementation factors were assessed. Linear and multilevel linear regression analyses were conducted to investigate associations between the implementation factors and (changes in) the determinants.

Results

Teachers, parents, and children were positive about nutrition education and highly appreciated TL(VM). Children's appreciation was positively associated with their change in awareness ($p<0.05$), self-efficacy ($p<0.01$), attitude ($p<0.01$), and intention ($p<0.05$). Parents' attitude and outcome expectancy towards nutrition education was positively associated with similar determinants before implementation of TL(VM), but not consistently with changes in the determinants during the programme. No consistent associations were found between school- and teacher-related factors and the determinants before or during the programme.

Conclusions

Only children's enjoyment of Taste Lessons enhanced the programme outcomes and therefore seems the most important factor for effective school-based nutrition education.

Introduction

In the past few decades, school-based nutrition education has increasingly been used to improve children's eating behaviours [1-3]. These nutrition education programmes differ in content, such as teaching methods, and parental involvement. Furthermore, most of the programmes are developed to be implemented by teachers themselves. Consequently, programme delivery and outcomes vary between studies [4-11].

In the literature, school-, teacher-, parent-, and child-related factors are reported that may influence the delivery and effectiveness of school-based nutrition education programmes. At school level, factors include nutrition policy and the available support, time, and resources for implementing nutrition education programmes [3, 11-17]. For teachers, the factors include perceived relevance and skills to teach nutrition, quality of how they implement the programme, and appreciation of the programme [1, 3, 6-8, 11-21]. With respect to parents, researchers have argued that parental involvement is essential in improving children's eating behaviour and is therefore likely to enhance the effectiveness of such programmes [2, 13, 17, 22-24]. Moreover, many studies show that children's engagement in programme activities influences the effect of nutrition education programmes, as interest increases learning [2, 11, 25-27].

Although some studies have linked one or more of these factors to the effectiveness of school-based nutrition education, little is known about how implementation factors are associated with programme implementation and effectiveness [11, 16]. In this study, we investigated the association between school-, teacher-, parent-, and child-related implementation factors and children's psychosocial determinants of vegetable consumption, both before and during the implementation of the Dutch school-based nutrition education programme Taste Lessons.

Methods

Intervention design

Taste Lessons (Smaaklessen) is a national, school-based nutrition education programme for grades 1–8 of Dutch primary schools (children aged 4–12 years). It was developed in 2006 and aims to interest children in taste, nutrition, and food quality through experiential learning methods. The programme consists of five lessons per grade about taste development, healthy eating, food production, consumer skills, and cooking skills. Each lesson takes on average 45 minutes

and includes plenary group talks and in-class hands-on activities. The lessons are implemented by the school teacher. Teaching materials consist of a teacher guide, Smartboard activities, and an online catalogue with additional ideas for each lesson. In 2013, a vegetable project for grades 6–7 was developed (children aged 10–11 years). This Taste Lessons Vegetable Menu (TLVM) consists of the five lessons from Taste Lessons (TL) and four additional activities: a cooking lesson with a dietician, a supermarket homework assignment, a vegetable quiz, and an excursion to a grower. In this study, the dietician and the excursion for TLVM were arranged by the research team. Before implementation of TL(VM), teachers received training during a kick-off meeting, in which they were informed about the content of the programme and how to implement the teaching materials.

Study design and procedure

This research was embedded in a larger effect evaluation with a quasi-experimental design, including two intervention groups (TL and TLVM) and a control group among 6th and 7th graders from 34 primary schools. Of this group, 11 schools implemented the Taste Lessons Vegetable Menu (TLVM), 11 schools implemented Taste Lessons (TL), and 12 schools took part in the study as a control group. In the current study, data for all three study groups were used to study the associations between the implementation factors and the programme outcome measures before implementation of TL(VM), and data for the intervention groups to study associations with the factors and changes in the programme outcome measures during implementation of the programme. Children received TL(VM) in the period March–April 2014. Measurements were carried out approximately one week before and after implementation, and took place in school during school time. The measurements in the control schools took place in the same period. Children took part in the study whose parents reported no refusal to participate. For the effect evaluation, children completed a questionnaire in class under supervision of a research assistant. Children also filled out a process evaluation questionnaire during the follow-up measurement. Prior to and after the intervention study, children received a questionnaire to take home for completion by one of their parents (on paper or online). Finally, teachers filled out a process evaluation questionnaire during the baseline and follow-up measurement.

Study population

Schools from the Dutch province of Gelderland were randomly assigned to one of the intervention groups or to the control group, invited by letter to participate in the study, and reminded by phone calls from employees of the municipal health service. Schools were excluded from the study if they were planning to implement other nutrition education programmes, or if children in the 6th and

7th grades had received Taste Lessons before. Of the 219 schools approached, 34 were willing to participate (16%). In total, 417 children with 18 teachers from 11 schools in the TLVM group, 285 children with 13 teachers from 11 schools in the TL group, and 308 children with 18 teachers from 12 schools in the control group participated in the study. Baseline and follow-up effect evaluation questionnaires were completed by 800 children (79% of the 1010 children). At the follow-up measurement, 551 children in the interventions groups filled out the process evaluation questionnaire (78%). Parents' questionnaires were completed by one of the parents of 492 children at baseline (49%) and by one of the parents of 239 children in the intervention groups at follow-up (34%). The baseline teacher questionnaire was filled out by 47 of the 48 teachers, and the follow-up teacher questionnaire by 26 of the 31 teachers in the intervention groups.

Measures

School-related factors

School nutrition policy was measured by means of six questions on the school's attitude and policy towards nutrition education answered by the teachers in their baseline questionnaire, on a 1 (totally disagree) – 5 (totally agree) Likert Scale (Table 1). During the follow-up measurement, teachers answered four questions on school support for the implementation of TL(VM) on the same scale.

Teacher-related factors

In the baseline questionnaire, nutrition education experience, self-efficacy, and attitude towards teaching nutrition education in general, and expectations of implementation of TL(VM) were measured (Table 1). Nutrition education experience was assessed by combining frequency and time spent on teaching nutrition in the categories: never or yearly <1 hour, yearly 1–3 hours, monthly 1–2 hours, and weekly 1–2 hours. Self-efficacy and attitude towards teaching nutrition were both measured by three questions on a 1 (totally disagree) – 5 (totally agree) Likert scale, based on the questionnaire used by Britten et al.(14) A mean score for each set of questions was calculated and used in the analyses. Implementation expectations of TL(VM) were measured at baseline by means of four questions on a 1 (totally disagree) – 5 (totally agree) Likert scale. Two questions were recoded for a higher score, meaning a positive expectation for all questions.

Teachers' presence at the kick-off meeting was reported using an attendance list which teachers signed during the meeting. In the follow-up questionnaire, motivation to implement TL(VM), implemented dose, used instructional strategies, and appreciation were measured. Motivation was measured by means

Table 1. Summary of the assessment methods and scores on the school-, teacher-, parent-, and child-related implementation factors.

Factors (answer scale or answers; number of items)	Item examples	Cronbach's α	N[1]	Mean (SD)/ Percentage
School-related factors				
School nutrition policy (1–5; 6)	- My school is positive about nutrition education	0.81	47	3.5 (0.6)
School support for TL(VM) (1–5; 4)	- There was regular feedback on the implementation of TL(VM)	0.64	26	3.1 (0.6)
Teacher-related factors				
Nutrition education experience (0–4; 2)	-	-	47	
- never/yearly < 1hour			7	14.3
- yearly 1–3 hours or monthly <1 hour			28	57.1
- monthly 1–2 hours or weekly <1 hour			11	22.4
- weekly 1–2 hours			1	2.1
Self-efficacy (1–5; 3)	- I have enough skills to teach about nutrition	0.68	47	3.7 (0.6)
Attitude (1–5; 3)	- It is important to teach children about nutrition	0.71	47	4.3 (0.5)
Implementation expectations of TL(VM) (1–5; 4)	- I expect that TL(VM) is nice to implement	0.63	27	3.3 (0.5)
Attendance kick-off of TL(VM) (yes/no; 1)	-	-	31	
- Yes			17	54.8
Intrinsic motivation for TL(VM) (1–7; 3)	- I implemented TL(VM) because I think it is interesting	0.76	26	6.0 (0.6)
Appreciation of TL(VM) (1–5; 10)	- I think TL(VM) was nice to implement	0.64	26	4.1 (0.3)
Instructional strategies used for TL(VM) (1–5; 10)	- While implementing TL(VM) I informed the children about the objective	0.88	26	4.2 (0.4)
Delivered dose of TL(VM) (0–1; 42)	-	-	27	0.7 (0.2)
Parent-related factors				
Attitude (1–5; 4)	- I think it is important that my child receives education about healthy nutrition	0.81	492	4.0 (0.6)
Outcome expectancy (1–5; 1)	- I think nutrition education will affect my child's eating behaviour	-	492	3.3 (0.9)
Involvement in TL(VM) (yes/no; 3)	-	-	239	
- Informed about TL(VM) by school			230	96.2
- Assisted at a TL(VM) activity			35	15.0
- Involved in TL(VM) in another way			26	10.9
Appreciation of TL(VM) (1–5; 1)	- I was enthusiastic about TL(VM)	-	239	4.0 (0.7)
Child-related factors				
Appreciation of TL(VM) (1–5; 1)	- How much did you like TL(VM)?	-	551	4.2 (0.9)
Interpersonal communication about TL(VM) (1–5; 1)	- Did you talk with others about TL(VM)?	-	549	2.9 (1.0)

[1] Number of teachers, parents and children who filled out the (set of) question(s).

of the four questions on intrinsic motivation of the Situational Motivation Scale on a 1 (totally disagree) – 7 (totally agree) Likert scale [29]. After one question was removed, internal consistency of the scale scored a Cronbach's α of 0.76. Teachers indicated which lesson elements they had implemented and, from this, dose was calculated by dividing the number of implemented lesson elements by the total available lesson elements. Used instructional strategies were assessed using the nine instructional events for qualitative teaching [19] in which teachers indicated how much they did or did not use the instructional strategies on a 1 (totally disagree) – 5 (totally agree) Likert scale. Because TL(VM) consists mainly of experiential learning activities, the strategy 'let children execute as many activities as possible' was added. Finally, appreciation of TL(VM) was measured by means of ten questions based on Dekker-Groen et al.'s [30] appreciation questionnaire. Teachers indicated their appreciation of different components of TL(VM) on a 1 (totally disagree) – 5 (totally agree) Likert scale. Two questions were recoded, for a higher score meaning a more positive appreciation for all questions.

Parent-related factors

At baseline, parents answered four questions on their attitude towards nutrition at school and one question about their outcome expectation of TL(VM) on a 1 (totally disagree) – 5 (totally agree) Likert scale (Table 1). During the follow-up measurement, parents indicated whether the school had informed them about TL(VM) (yes or no), whether they had assisted at one of the activities (yes or no), and whether they had been involved in the programme in any other way (yes or no). Furthermore, parents indicated whether they were enthusiastic about the programme on a 1 (totally disagree) – 5 (totally agree) Likert Scale.

Child-related factors

During the follow-up measurement, children answered a question on how they appreciated TL(VM) in general on a 1 (totally disagree) – 5 (totally agree) Likert scale, and a question on whether they talked about the programme after the lessons (interpersonal communication) on a 1 (never) – 5 (always) scale (Table 1).

Programme outcome measures

At both the baseline and the follow-up measurement, children completed a questionnaire on psychosocial determinants (knowledge, awareness, self-efficacy, attitude, subjective norm (of parents and the teacher), and intention) of vegetable consumption. Knowledge was measured by means of five multiple choice questions. The score of correct answers was used for the analyses. All other determinants were measured by means of a set of five to eight questions on Likert scales ranging from 1 (totally disagree) – 5 (totally agree) of which the

Table 2. Socio-demographic characteristics of the children, mothers, teachers and schools.

	TLVM		TL		Control	
	N	% / Mean (SD)	N	% / Mean (SD)	N	% / Mean (SD)
Children (n=800)						
Age (in years)	331	10.4 (0.7)	237	10.3 (0.7)	232	10.4 (0.7)
Grade						
- Grade 6	178	54	114	48	121	52
- Grade 7	153	46	123	52	111	48
Sex						
- Boy	159	48	114	48	113	49
- Girl	172	52	123	52	119	51
Ethnicity[1]						
- Dutch	197	90	102	89	117	92
- Non-Dutch	22	10	13	11	10	8
Mothers (n=448)						
Age (in years)[2]*	214	40.6 (4.2)	108	42.2 (3.6)	115	41.3 (3.9)
Marital status						
- Married / cohabiting	208	94	98	89	106	91
- Unmarried / divorced / widowed	13	6	12	11	11	9
Educational level[3]*						
- Low	40	18	12	11	12	11
- Middle	112	52	54	51	61	53
- High	65	30	41	38	41	36
Teachers (n=47)						
Age (in years)	16	42.9 (13.5)	13	38.9 (10.7)	17	38.1 (10.8)
Teaching experience (in years)	16	18.3 (13.0)	13	15.5 (11.1)	18	11.8 (9.8)
Sex						
- Male	3	19	1	8	2	11
- Female	13	81	12	92	16	89
Schools (n=34)						
Religious principle						
- Non-denominational	3	27	5	46	6	50
- Religious	8	73	6	54	6	50
Size*						
- Small	2	18	8	73	9	75
- Medium	5	46	2	18	3	25
- Large	4	36	1	9	0	0
Location						
- Town	3	27	4	36	6	50
- Small city	7	64	4	36	2	17
- City	1	9	3	27	4	33

[1] Assessed by questions on country of birth in the parent's questionnaire, N=461. [2-3] N=437 and 438, respectively. * Significant difference between the three study groups.

mean scores were used (Cronbach's α >0.65 for each set of questions). Change scores were calculated as the difference in the sum, mean, or item scores between the baseline and follow-up measurement and used in the analyses.

Socio-demographic characteristics

School size (small (<150 students), medium (150–250 students) or large (>250 students)), location (town (<10,000 inhabitants), semi-city (10,000–100,000 inhabitants), or city >100,000 inhabitants)) and principle (religious or public) were obtained from the online database for Dutch primary schools [28]. Teachers' age and sex and children's date of birth, grade, and sex were measured in their baseline questionnaire. The parents' baseline questionnaire included questions on the ethnicity of the child and parents (country of birth), age, educational level (low, middle, high), and marital status (married, cohabiting, unmarried, divorced, widowed). Children were classified as non-Dutch if they or one of their parents were born outside the Netherlands. Data on the mothers' socio-demographic characteristics were used in the analyses.

Statistical analyses

First, descriptive analyses were performed using SPSS Statistics (version 22) to describe the socio-demographic characteristics of all the study groups, and implementation and appreciation of TL(VM) in the intervention groups. Second, the associations between the implementation factors and (changes in) children's determinants before and during implementation of TL(VM) were tested using linear regression analyses. The associations between parent- and child-related factors and (changes in) children's determinants were tested using 'normal' linear regression analyses in SPSS. The associations between school- and teacher-related factors and (changes in) children's determinants were tested using multilevel linear regression analyses in statistical programme HLM (version 7). Two levels were included: children (1) and class (2). Potential confounders were tested by adding the socio-demographic characteristics to the model one by one, but none was found to materially affect the effect estimates. Results were interpreted as significant when $p<0.05$ (two-sided).

Results

Socio-demographic characteristics of the study population

All three study groups included mainly children of Dutch origin with a mean age of ten years old (Table 2). Mothers of children in the TLVM group were on average somewhat younger and less educated, and teachers somewhat older and more experienced than those in the other groups. Also, the TLVM group included more large schools and more schools with a religious principle than the two other groups.

Implementation factors regarding nutrition education and TL(VM)

Teachers in all three study groups reported that their schools were positive about nutrition education, but they were more neutral about having a nutrition policy. Most schools therefore scored moderately on school nutrition policy (Table 1). Teachers taught nutrition several hours a year. Their mean scores for attitude and self-efficacy towards teaching nutrition were relatively high (mean scores of 4.3 and 3.7, respectively). Parents thought that nutrition education in their child's school was important (mean score 4.0).

Teachers in the interventions groups scored moderately on perceived support from their school for implementing TL(VM). About half of the teachers attended the kick-off meeting. Teachers were highly motivated to implement the programme (mean score 6.0), but expected that the preparation and implementation of TL(VM) would take a lot of time. The teachers implemented on average 75% of the available lesson elements and generally applied all instructional strategies (mean score 4.2). Almost all parents were informed about TL(VM) by the school (96%), but only few had assisted at an activity or had been involved in another way (15% and 11%, respectively). The teachers, parents, and children highly appreciated TL(VM) (mean score 4.1, 4.0, and 4.2, respectively). Finally, the children on average sometimes talked with others about the lessons and activities (mean score 2.9).

Associations with children's determinants at baseline

Of the parent-related factors, significantly positive associations were found between parents' attitude on nutrition education and their child's awareness ($p<0.01$), self-efficacy ($p<0.01$), attitude ($p<0.001$), subjective norm of their parents ($p<0.05$), and intention ($p<0.01$) towards vegetable consumption (Table 3). Also, parents' outcome expectancy was positively associated with their child's attitude ($p<0.01$), subjective norm of their parents ($p<0.05$) and of their teacher ($p<0.001$), and intention ($p<0.01$). No significant associations were observed between the school- and teacher-related factors and children's

Table 3. Associations between the implementation factors and children's psychosocial determinants before TL(VM) implementation

	Knowledge	Awareness	Self-efficacy	Attitude	Subjective norm - parents	Subjective norm - teacher	Intention
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
School[1]							
School nutrition policy	-0.1 (0.1)	0.0 (0.1)	0.1 (0.1)	0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	0.1 (0.1)
Teacher[1]							
Nutrition education experience	0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.1)	0.0 (0.1)
Self-efficacy	0.1 (0.1)	-0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.2 (0.1)*	0.1 (0.1)
Attitude	-0.2 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)	0.0 (0.1)
Parents[2]							
Attitude	0.1 (0.1)	0.2 (0.1)**	0.1 (0.1)**	0.2 (0.1)***	0.1 (0.1)*	0.1 (0.1)	0.2 (0.1)*
Outcome expectancy	0.0 (0.1)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)**	0.1 (0.0)*	0.2 (0.1)***	0.1 (0.0)**

[1] Regression coefficients, assessed with multilevel linear regression analyses in HLM.[2] Regression coefficients, assessed with linear regression analyses in SPSS.* p<0.05, ** p<0.01, *** p<0.001

Table 4. Associations between the implementation factors and children's change in psychosocial determinants during TL(VM) implementation

	Knowledge	Awareness	Self-efficacy	Attitude	Subjective norm - parents	Subjective norm - teacher	Intention
	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)	β (SE)
School[1]							
School nutrition policy	0.0 (0.1)	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.1)	0.1 (0.1)	0.1 (0.1)
School support for TL(VM)	0.2 (0.2)	-0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	0.1 (0.1)	0.2 (0.1)	-0.1 (0.1)
Teacher[1]							
Nutrition education experience	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-0.1 (0.0)*	0.0 (0.0)	0.0 (0.0)
Self-efficacy	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	-0.2 (0.1)	-0.1 (0.1)
Attitude	0.3 (0.2)*	-0.2 (0.1)*	-0.1 (0.1)*	0.0 (0.1)*	-0.1 (0.1)	0.2 (0.1)	0.0 (0.1)
Implementation expectations of TL(VM)	0.0 (0.2)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.0 (0.1)	0.3 (0.1)*	-0.1 (0.1)
Attendance kick-off of TL(VM)	0.0 (0.1)	-0.1 (0.1)	0.0 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)	-0.1 (0.1)
Intrinsic motivation for TL(VM)	0.0 (0.1)	-0.1 (0.1)	0.1 (0.0)	0.1 (0.0)	0.0 (0.1)	0.2 (0.1)	-0.1 (0.1)
Appreciation of TL(VM)	0.3 (0.2)	-0.2 (0.1)	0.0 (0.1)	0.1 (0.1)	-0.1 (0.1)	0.3 (0.2)	-0.1 (0.1)
Instructional events used for TL(VM)	0.3 (0.2)	-0.2 (0.1)*	0.0 (0.1)	0.0 (0.1)	-0.1 (0.1)	0.1 (0.2)	-0.1 (0.1)
Delivered dose of TL(VM)	0.3 (0.5)	-0.1 (0.2)	0.2 (0.2)	0.1 (0.2)	-0.1 (0.2)	0.3 (0.3)	-0.1 (0.3)
Parents[2]							
Attitude	-0.1 (0.1)	0.0 (0.1)	0.0 (0.1)	-0.1 (0.0)	0.1 (0.1)	0.0 (0.1)	0.0 (0.1)
Outcome expectancy	0.0 (0.1)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	-0.1 (0.1)	0.0 (0.0)
Informed about TL(VM) by school	0.4 (0.4)	0.1 (0.3)	-0.1 (0.2)	0.2 (0.2)	0.4 (0.2)	0.1 (0.3)	0.4 (0.3)
Assisted at a TL(VM) activity	-0.2 (0.2)	0.0 (0.1)	0.1 (0.1)	-0.2 (0.1)*	0.0 (0.1)	-0.1 (0.2)	-0.3 (0.1)*
Involved in TL(VM) in another way	-0.2 (0.3)	0.0 (0.2)	0.1 (0.1)	0.0 (0.1)	0.4 (0.1)**	0.3 (0.2)	0.2 (0.2)
Appreciation of TL(VM)	0.0 (0.1)	0.1 (0.1)	0.0 (0.1)	0.1 (0.0)	0.1 (0.1)	0.1 (0.1)	0.1 (0.1)
Children[2]							
Appreciation of TL(VM)	0.1 (0.1)	0.1 (0.0)*	0.1 (0.0)**	0.1 (0.0)**	0.0 (0.0)	0.1 (0.0)	0.1 (0.0)*
Interpersonal communication about TL(VM)	-0.1 (0.1)*	0.1 (0.0)**	0.1 (0.0)	0.0 (0.0)	0.0 (0.0)	0.1 (0.0)	0.0 (0.0)

[1] Regression coefficients, assessed with multilevel linear regression analyses in HLM. [2] Regression coefficients, assessed with linear regression analyses in SPSS. * p<0.05, ** p<0.01, *** p<0.00

determinants at baseline, expect for teacher's self-efficacy on teaching nutrition and children's subjective norm of their teacher ($p<0.05$).

Associations with changes in children's determinants

Positive associations were found between children's programme appreciation and changes in their awareness ($p<0.05$), self-efficacy ($p<0.01$), attitude ($p<0.01$), and intention ($p<0.05$) towards vegetable consumption (Table 4). Furthermore, children's interpersonal communication about TL(VM) was positively associated with their change in awareness ($p<0.01$), but negatively with their change in knowledge ($p<0.05$). No consistent associations were observed between the school-, teacher-, and parent-related implementation factors and children's changes in the determinants during TL(VM) implementation.

Discussion

The aim of this study was to investigate the influence of implementation factors on children's psychosocial determinants of vegetable consumption before and during TL(VM). Schools, teachers and parents were positive about nutrition education, of which parent's attitude and outcome expectancy showed significant positive associations with their child's psychosocial determinants of vegetable consumption. Teachers, parents, and children highly appreciated TL(VM), but only children's appreciation showed consistent positive associations with change in their psychosocial determinants. Almost no associations were found between the other implementation factors and the programme outcomes.

Schools were recruited for this study via an invitation to participate in a randomly allocated study group. It is likely that only a selective group of highly motivated teachers were willing to implement the TLVM, because this programme is quite intensive and nutrition education is not mandatory in the Dutch school system. This may have caused the small differences in the socio-demographic characteristics between the TLVM and the two other study groups. However, almost no differences were observed in the outcome measures, and adding the socio-demographic characteristics as covariates in the models did not materially change the observed associations. Therefore, selection bias is not likely to have influenced the results.

Most data in this study were collected using self-report with questionnaires. This could have led to measurement errors and socially desirable answers. To reduce measurement errors, all questionnaires were pretested on readability, length, and answer categories by a number of teachers, adults, and children who did not participate in the study. Furthermore, children completed the questionnaires under supervision of the research team, who also instructed the children on

how to fill in the questionnaires. Finally, questions and answers in the children's questionnaires were based on questionnaires used in former evaluation studies conducted in the same age groups.

In this study, almost no associations were found for school- and teacher-related factors and (changes in) the programme outcome measures. The small variation in the answers between teachers limited the opportunity to explain differences in the programme outcomes by these factors. As mentioned before, this may be because the teachers who were willing to participate in the study were highly motivated. In addition, giving answers that were socially desirable could have resulted in mainly positive answers and little variance between teachers. Making use of observation methods to measure teachers' behaviour during the lessons might obtain more objective results. Shin et al. [6] observed teachers during the implementation of prevention interventions and found that teachers differed in engagement and delivery techniques. Also, a significant dose–response association was found between outcomes of the nutrition education programme 'Gimme5' and interview completeness, but not with teachers' self-reported completeness [31]. However, variation in teacher quality may be also driven by characteristics that are difficult to measure [32]. Therefore, it is still unclear to what extent teacher-related factors influence programme outcomes.

In this study, teachers' attendance at the kick-off meeting was recorded by the research team. About half of the teachers in the intervention groups attended this meeting. Although no significant associations were found between this and changes in the programme outcomes, it was positively correlated with teachers' self-efficacy to implement TL(VM) (data not shown). Britten et al. [14] also found an association between training and teachers' self-efficacy for teaching nutrition education. Several studies have shown that both training and self-efficacy are associated with time spent on teaching nutrition [1, 14, 17, 33], but no such association was found in the current study. Britten et al. suggested that training is not necessary in some cases and not sufficient in other cases to ensure complete and appropriate implementation [14]. More research is needed to investigate whether and how training could enhance the implementation and effectiveness of nutrition education programmes.

Parents' attitude on nutrition education was associated with children's psychosocial determinants of vegetable consumption at baseline, but not with change in the programme outcomes during implementation of TL(VM). Also parental involvement and programme appreciation did not show consistent associations with changes in the programme outcomes. These findings suggest that the home environment plays an important role in the development of children's eating behaviour [34, 35], but that the influence of parent-related factors on programme effectiveness is limited. However, some other studies have

found higher programme outcomes with higher levels of parental involvement [23, 36, 37]. The parental participation in the current programme activities was low: about 15% of the parents who completed the questionnaire reported that they had helped with an activity and about 10% that they were involved in another way. Other studies on school-based nutrition education programmes have also reported low levels of parental participation [2, 38, 39]. Bere et al.'s study [40] found higher intervention effects with parents' usage of newsletters, but not with attendance at arranged meetings. As parents influence children's determinants of vegetables consumption, appropriate ways must be sought to increase parental involvement for enhancing effectiveness of school-based nutrition education programmes.

Children's appreciation of TL(VM) showed the most and strongest positive associations with the programme outcomes. This finding is in line with literature suggesting that children's interest and engagement in programme activities increase learning outcomes [25-27, 41]. Children's appreciation was also positively associated with the programme outcomes in the former evaluation study of Taste Lessons, as well as in studies on 'ProChildren' and on 'Fruit and Vegetables Make the Marks' [36, 40]. Teachers and parents highly appreciated TL(VM) as well, but their appreciation did not show consistent associations with the programme outcomes. Therefore it seems that children's enjoyment is an indicator for effectiveness of school-based nutrition education.

Conclusions

Teachers, parents, and children were positive about nutrition education and highly appreciated TL(VM). Parents' attitude on nutrition education was positively associated with children's determinants of vegetable consumption, but only children's programme appreciation enhanced the programme outcomes. Therefore children's enjoyment of the programme activities seems the most important factor for effective school-based nutrition education.

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References

1. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
2. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1a):131-9.
3. van Nassau F, Singh AS, van Mechelen W, Brug J, Chinapaw MJM. Implementation evaluation of school-based obesity prevention programmes in youth; how, what and why? Public Health Nutrition. 2015;18(09):1531-4.
4. He L, Zhai Y, Engelgau M, Li W, Qian H, Si X, et al. Association of children's eating behaviors with parental education, and teachers' health awareness, attitudes and behaviors: a national school-based survey in China. Eur J Public Health. 2014; 24(6): 880–887.
5. Kain J, Uauy R, Albala, Vio F, Cerda R, Leyton B. School-based obesity prevention in Chilean primary school children: methodology and evaluation of a controlled study. Int J Obes Relat Metab Disord. 2004;28(4):483-93.
6. Shin Y, Miller-Day M, Pettigrew J, Hecht ML, Krieger JL. Typology of delivery quality: latent profile analysis of teacher engagement and delivery techniques in a school-based prevention intervention, keepin' it REAL curriculum. Health Education Research. 2014;29(6):897-905.
7. Ribeiro RQ, Alves L. Comparison of two school-based programmes for health behaviour change: the Belo Horizonte Heart Study randomized trial. Public Health Nutrition. 2014;17(06):1195-204.
8. Shannon B, Marbach ES, Graves K, Sims LS. Nutrition knowledge, attitudes, and teaching effectiveness of K-6 teachers. Journal of Nutrition Education. 1981;13(4):145-9.
9. Durlak JA, DuPre EP. Implementation Matters: A Review of Research on the Influence of Implementation on Program Outcomes and the Factors Affecting Implementation. American Journal of Community Psychology. 2008;41(3-4):327-50.
10. Dusenbury L, Brannigan R, Hansen WB, Walsh J, Falco M. Quality of implementation: developing measures crucial to understanding the diffusion of preventive interventions. Health Education Research. 2005;20(3):308-13.
11. Gray HL, Contento IR, Koch PA. Linking implementation process to intervention outcomes in a middle school obesity prevention curriculum, 'Choice, Control and Change'. Health Education Research. 2015.
12. Aarestrup AK, Jørgensen TS, Jørgensen SE, Hoelscher DM, Due P, Krølner R. Implementation of strategies to increase adolescents' access to fruit and vegetables at school: process evaluation findings from the Boost study. BMC public health. 2015;15(1):86.
13. Bergström H, Haggård U, Norman Å, Sundblom E, Elinder LS, Nyberg G. Factors influencing the implementation of a school-based parental support programme to promote health-related behaviours—interviews with teachers and parents. BMC public health. 2015;15(1):541.
14. Britten P, Lai MK. Structural Analysis of the Relationships among Elementary Teachers' Training, Self-Efficacy, and Time Spent Teaching Nutrition. Journal of Nutrition Education. 1998;30(4):218-24.
15. Friend S, Flattum CF, Simpson D, Nederhoff DM, Neumark-Sztainer D. The Researchers Have Left the Building: What Contributes to Sustaining School-Based Interventions Following the Conclusion of Formal Research Support? Journal of School Health. 2014;84(5):326-33.
16. Langford R, Bonell C, Jones H, Campbell R. Obesity prevention and the Health promoting Schools framework: essential components and barriers to success. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):15.
17. Stang J, Story M, Kalina B. Nutrition Education in Minnesota Public Schools: Perceptions and Practices of Teachers. Journal of Nutrition Education. 1998;30(6):396-404.
18. Christian MS, Evans CE, Ransley JK, Greenwood DC, Thomas JD, Cade JE. Process evaluation of a cluster randomised controlled trial of a school-based fruit and vegetable intervention: Project Tomato. Public Health Nutrition. 2012;15(03):459-65.
19. Gagné RM, Briggs LJ. Principles of Instructional Design. Second ed1979.
20. Smith NJ, Monnat SM, Lounsbery MAF. Physical Activity in Physical Education: Are Longer Lessons Better? Journal of School Health. 2015;85(3):141-8.

21. Clotfelter CT, Ladd HF, Vigdor JL. Teacher credentials and student achievement: Longitudinal analysis with student fixed effects. Economics of Education Review. 2007;26(6):673-82.
22. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: A systematic review. Preventive Medicine. 2006;42(2):85-95.
23. Niemeier BS, Hektner JM, Enger KB. Parent participation in weight-related health interventions for children and adolescents: A systematic review and meta-analysis. Preventive Medicine. 2012;55(1):3-13.
24. Peters LW, Kok G, Ten Dam GT, Buijs GJ, Paulussen TG. Effective elements of school health promotion across behavioral domains: a systematic review of reviews. BMC public health. 2009;9(1):182.
25. Cheng FW, Monnat SM, Lohse B. Middle School-Aged Child Enjoyment of Food Tastings Predicted Interest in Nutrition Education on Osteoporosis Prevention. Journal of School Health. 2015;85(7):467-76.
26. Roorda DL, Koomen HMY, Spilt JL, Oort FJ. The Influence of Affective Teacher–Student Relationships on Students' School Engagement and Achievement: A Meta-Analytic Approach. Review of Educational Research. 2011;81(4):493-529.
27. Schraw G, Flowerday T, Lehman S. Increasing Situational Interest in the Classroom. Educational Psychology Review. 2001;13(3):211-24.
28. Onderwijsdata - primair onderwijs. Dienst Uitvoering Onderwijs - Ministerie van Onderwijs, Cultuur en Wetenschap. Cited December 2012. Available from: www.duo.nl.
29. Guay F, Vallerand RJ, Blanchard C. On the assessment of situational intrinsic and extrinsic motivation: The Situational Motivation Scale (SIMS). Motivation and Emotion. 2000;24(3):175-213.
30. Dekker-Groen AM, van der Schaaf MF, Stokking KM. A teacher competence development programme for supporting students' reflection skills. Teachers and Teaching. 2012;19(2):150-71.
31. Resnicow K, Davis M, Smith M, Lazarus-Yaroch A, Baranowski T, Baranowski J, et al. How best to measure implementation of school health curricula: a comparison of three measures. Health Education Research. 1998;13(2):239-50.
32. Rockoff JE. The Impact of Individual Teachers on Student Achievement: Evidence from Panel Data. The American Economic Review. 2004;94(2):247-52.
33. Soliah L, Newell G, Vaden A, Dayton A. Establishing the need for nutrition education: II. Elementary teachers' nutrition knowledge, attitudes, and practices. Journal of the American Dietetic Association. 1983;83(4):447-53.
34. Birch LL. Development of food acceptance patterns in the first years of life. The Proceedings of the Nutrition Society. 1998;57(4):617-24.
35. Couch SC, Glanz K, Zhou C, Sallis JF, Saelens BE. Home Food Environment in Relation to Children's Diet Quality and Weight Status. Journal of the Academy of Nutrition and Dietetics. 2014;114(10):1569-79.e1.
36. Wind M, Bjelland M, Pérez-Rodrigo C, Te Velde SJ, Hildonen C, Bere E, et al. Appreciation and implementation of a school-based intervention are associated with changes in fruit and vegetable intake in 10- to 13-year old schoolchildren - The Pro Children study. Health Education Research. 2008;23(6):997-1007.
37. te Velde SJ, Wind M, van Lenthe FJ, Klepp KI, Brug J. Differences in fruit and vegetable intake and determinants of intakes between children of Dutch origin and non-Western ethnic minority children in the Netherlands - a cross sectional study. The international journal of behavioral nutrition and physical activity. 2006;3:31.
38. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. Journal of Human Nutrition and Dietetics. 2005;18(6):431-43.
39. Langford R, Bonell C, Jones H, Campbell R. Obesity prevention and the Health promoting Schools framework: essential components and barriers to success. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):1-17.
40. Bere E, Veierød MB, Bjelland M, Klepp K-I. Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM). Health Education Research. 2006;21(2):258-67.
41. Dazeley P, Houston-Price C, Hill C. Should healthy eating programmes incorporate interaction with foods in different sensory modalities? A review of the evidence. British Journal of Nutrition. 2012;108(05):769-77.

6

General discussion

Main findings

The objective of this thesis was to investigate the effectiveness of nutrition education in Dutch primary schools, by conducting two evaluation studies on the implementation and the effectiveness of the school-based nutrition education programme Taste Lessons. The first study evaluated the implementation and the effectiveness of the first version of Taste Lessons on its aim of increasing children's interest in food, and their knowledge and skills regarding healthy and conscious eating behaviour. This was done by measuring process indicators and changes in psychosocial determinants of the target behaviours during the programme's implementation by teachers in one school year. The second study evaluated the implementation and the effectiveness of a second version of Taste Lessons with and without additional experiential learning activities on increasing children's psychosocial determinants of vegetable consumption. Also, behavioural outcomes regarding vegetable consumption were measured in this second study. Table 1 presents a summary of the findings in this thesis, integrated in the Intervention Logic Model.

The first study showed that partial implementation of the 10–12 lessons of Taste Lessons (first version) resulted in small intervention effects on psychosocial determinants of eating behaviour: the intervention group showed a higher increase in knowledge (d=0.3), subjective norm of the teacher, and intention (both d=0.2) than the control group (*chapter two*). The effect on knowledge still persisted six months after the programme (d=0.2). With almost complete implementation of the five lessons of Taste Lessons over a couple of weeks, the second study showed similar results to the first study, with knowledge as the most profound intervention effect (d=0.4; *chapter four*). Additional experiential learning activities, such as an extended cooking lesson with a dietician and the parents, an excursion to a grower, and a supermarket assignment with the parents, showed more and stronger increases in several psychosocial determinants of vegetable consumption: the TLVM group showed a higher increase in knowledge (d=0.5), attitude, and subjective norm of the teacher (both d=0.2) than the control group (*chapter four*). Also, the extended format showed significantly higher increases in children's subjective norm of the teacher and cooking self-efficacy than Taste Lessons without these additional activities (both d=0.2). No significant intervention effects were found on children's willingness to taste unfamiliar vegetables, food neophobia, and daily vegetable consumption (*chapter five*). These results suggest that implementation of Taste Lessons during a single school-year was effective in increasing short-term objectives of the programme, and that the effect on knowledge persisted over a longer period of time (see the right side of Table 1).

Table 1. Summary of the main findings of this thesis, integrated in the Intervention Logic Model.

Input	Activities	Output	Short-term outcomes	Longer-term outcomes
Requirements for implementation	The lessons / activities of Taste Lessons	Process of implementation	Changes in psychosocial determinants	Changes in actual behaviour
Intervention theory				
1. Materials 2. Money 3. Time 4. Cooperation of schools and teacher	1. Group talks 2. Taste testing 3. Experiments 4. Assignments 5. Information	1. Dose: number of lessons and activities 2. Quality of delivery, methods used 3. Appreciation	Increase in children's knowledge about, and interest in, food, nutrition, and food quality	Increase in number of children who taste unfamiliar foods, eat healthily and a variety of foods, and pay attention to how foods are produced
Results from the two studies conducted				
Materials • Highly appreciated by the teachers Money and time • Perceived as limitedly available • Reason for incomplete implementation Cooperation • Teachers perceive support from school • Teachers are motivated to implement nutrition education • Parents perceive nutrition education as important • Low parental involvement in activities	First version of Taste Lessons (TL1) • 10-12 lessons per every two grades Second version of Taste Lessons (TL2): • 5 lessons per grade Second version of Taste Lessons with additional experiential learning activities (TLVM): • TL2 with four additional experiential learning activities	Dose • TL1: 4.6 • TL2: 4.5 • TLVM: 4.7 + most of the additional activities • No clear associations with the outcomes Quality of delivery • Most instructional strategies used • No clear associations with the outcomes Appreciation by children • Children highly liked the programme and sometimes talked about the lessons • Positive associations with changes in several programme outcomes	Programme effects on[1]: Knowledge • TL1: ++ <++> • TL2: +++ • TLVM: +++ (+) Awareness • TL1: 0 • TL2: 0 • TLVM: 0 Skills/self-efficacy • TL1: 0 • TL2: 0 • TLVM: 0 Attitude/emotion • TL1: 0 • TL2: + • TLVM: + Subjective norm - teacher • TL1: + • TL2: 0 • TLVM: ++ (+) Subjective norm - parents • TL1: 0 • TL2: 0 • TLVM: 0 Subjective norm - classmates • TL1: 0 Intention • TL1: + • TL2: + • TLVM: 0	Programme effects[1]: Self-reported number of foods known and tasted • TL1: ++ Number of familiar vegetables tasted • TL2: ++ • TLVM: ++ Number of un-familiar vege-tables tasted • TL2: 0 • TLVM: 0 Quantity of (un)-familiar vegetables tasted • TL2: 0 • TLVM: 0 Choice of vegetable of which to eat more • TL2: 0 • TLVM: 0 Number of (un) familiar vegetables willing to taste again later • TL2: 0 • TLVM: 0 Daily vegetable consumption • TL2: 0 • TLVM: 0 Food neophobia • TL2: 0 • TLVM: 0

[1] Change in intervention group (TL1/TL2/TLVM) vs. control group (if measured) directly after the intervention: 0=*d*<0.15, +=*d* 0.15–0.20, ++=*d* 0.20–0.30, +++=*d*>0.30. Between pointy brackets: intervention effect after six months. Between normal brackets: change in TLVM group vs. TL2 group.

Analyses of process indicators in both studies revealed that teachers, parents, and children highly liked Taste Lessons (the left side of Table 1). Children most liked the experiential learning activities. Furthermore, children's programme appreciation and interpersonal communication about the programme activities were found to be positively associated with changes in the programme outcomes (*chapters three and six*).

Methodological considerations

Study design and participants

In our two studies, we used a quasi-experimental design. This means that we did not randomise schools in either the intervention or the control group after recruiting the schools to participate in the study. For recruitment, different procedures were used. In the first study, schools that had registered for Taste Lessons and had followed an introductory workshop were invited to join the intervention group, whereas a list with all primary schools in the Netherlands was consulted to recruit schools for the control group (*chapter two*). In the second study, all primary schools in the Dutch province of Gelderland were randomly assigned to one of the intervention groups or to the control group before recruiting the schools, and thereafter invited to participate in the study in that specific study group (*chapter four*). As schools have limited time and resources for nutrition, random allocation of the intervention programme to the schools in practice-based research is difficult. The use of a quasi-experimental design may, therefore, have resulted in a higher willingness to participate and lower dropout numbers.

Asking schools to participate in one of the study groups instead of randomising the schools in one of the study groups after recruiting them, however, may have induced selection bias. More motivated teachers, for example because children in their class ate unhealthily, might have been willing to participate in the intervention group, whereas more science-supporting teachers might have been willing to participate in the control group. Indeed, the results of both studies showed some socio-demographic differences between the schools and the children in the intervention and the control group. For example, the control group in both studies included more schools and children with a higher socio-economic status than the intervention groups. These differences could have influenced the results of our study. However, the socio-demographic differences were evaluated for their relation with the outcome measures (confounding), and did not seem to materially affect the effect estimates. Therefore, it is considered unlikely that these differences in characteristics might have explained children's

changes in the outcome measures. Furthermore, characteristics of the schools in either the intervention or the control group might reflect which schools do or do not implement nutrition education in practice.

Data collection and measurement procedures

In our studies, the effectiveness of Taste Lessons on children was assessed by collecting data from children themselves. In both studies, questionnaires were used that children filled out on paper in their class during school time under supervision of their teacher and a member of the research team. The questionnaires for these evaluations were developed from existing questionnaires, paying attention to children's cognitive capabilities. Subsequently, the questionnaires were pilot tested before the start of the study by a few children who did not participate in the study.

Although children were instructed on how to fill out the questionnaire and not many questions were asked during the measurements, measurement errors might have biased our results. For example, children's cognitive capabilities may still have been too limited for them to sufficiently understand the questions and provide appropriate answers. Also, the children might have provided socially desirable answers, especially because the questionnaires were administered in the school setting. However, the data indicated that most questionnaires were filled out as instructed and realistic answers were provided.

In the second evaluation study, children were asked not only to fill out a questionnaire, but also to participate in a taste test (*chapter five*). This taste test was performed outside the classroom with one child and one research team member each time. Taste tests may have provided a more objective estimation of willingness to taste vegetables than using a questionnaire, but conducting taste tests in the school setting had some limitations. Differences between research members and test locations in the schools may have influenced children's willingness to taste the vegetables. However, as change in willingness to taste the vegetables was used as an outcome measure, it is not likely that these differences had a major influence on the results of this study.

Outcome measures

To measure the effectiveness of Taste Lessons, children's psychosocial determinants of healthy and conscious eating behaviour were assessed as the main outcome measures in both studies. These outcomes were chosen because Taste Lessons aims to interest children in food and increase their knowledge and skills for making healthy and conscious food choices. As Taste Lessons is a practice-driven programme that was developed without using a particular behavioural change theory to formulate its objectives and activities, the Theory

of Planned Behaviour [1] and the Integrated Model of Behaviour [2] were used to select appropriate outcome measures for assessing the effectiveness of the programme. In addition to knowledge and skills/self-efficacy, children's attitude/emotion, subjective norm, and intention were used as outcome measures. Using these determinants as outcome measures, however, may have had some limitations. It is possible that other determinants would have provided a better estimation of Taste Lessons' effectiveness, such as preferences or availability of vegetables. However, a review of the literature on using the Theory of Planned Behaviour for measuring children's eating behaviour concluded that psychosocial determinants may be useful to identify factors relating to children's eating behaviour, and therefore useful as outcome measures for intervention programmes [3].

Discussion of findings

The effectiveness of school-based nutrition education

Taste Lessons aims to interest children in food and to increase their knowledge and skills for making healthy and conscious food choices. The results suggest that Taste Lessons achieved most of its goals. Significant intervention effects were found on knowledge and several other psychosocial determinants of healthy and conscious eating behaviour. With an average of about five lessons of the Taste Lessons programme during a single school-year, the results of the two evaluation studies showed small intervention effects on children's knowledge, subjective norm of the teacher, and intention towards healthy eating behaviour (*chapters two and four*; Table 1). The strongest effect was found on knowledge, which still persisted six months after implementation of the programme (*chapter two*; Table 1).

Other national and international school-based nutrition education programmes have also shown an increase in children's knowledge as the most profound intervention effect. Evaluation of the Dutch local programme De Gezonde HAP&STAP Vierdaagse, consisting of a guest lesson by a dietician, a taste lesson from a cook, a dance lesson, and a 'culinary walk', found an increase in knowledge, but not in awareness and attitude [4]. Evaluation of 'SchoolGruiten', consisting of the provision of fruit and vegetables twice a week and 10 optional lessons, showed an increase in knowledge and in fruit consumption, but not in vegetable consumption [5]. Evaluation studies of programmes in other countries have also shown an increase in children's knowledge in almost all programmes, and less often in increasing children's attitude, subjective norm, and intention [6-18].

Besides psychosocial determinants, the effectiveness of Taste Lessons was assessed on behavioural outcomes. In the second evaluation study, this was assessed by children's willingness to taste unfamiliar vegetables and daily vegetable consumption. The results showed that Taste Lessons, including with additional experiential learning activities, was not able to achieve a significant effect on these outcomes (*chapter five*; Table 1). Some other programmes did find an effect on either increasing children's willingness to taste unfamiliar vegetables [16, 19, 20] or daily vegetable consumption [21-24], but others did not [5, 15-17, 20, 25]. The literature argues that, even when effects are found, increases in children's vegetable consumption are minimal [18, 26].

Together with the fact that Taste Lessons does not primarily aim to increase children's vegetable consumption and has no specific activities to reach this aim, the results from our and other studies support the idea that school-based nutrition education is not effective in changing children's actual eating behaviour. Improving children's eating behaviour is a difficult task, as their intake is mainly influenced by (innate) preferences and their parents' food choices and eating practices [27-29]. Moreover, increasing children's vegetable consumption with a school programme in the Netherlands might be difficult because, in line with Dutch eating habits, vegetables are eaten mostly at the evening meal, and no school meals are offered at lunchtime [5]. Furthermore, schools have limited time for nutrition education. Nutrition education is not mandatory in Dutch primary schools, and teachers allocate seven to eight hours for nutrition education per year on average, divided over several projects and courses [30]. Therefore, expecting a change in children's psychosocial determinants of eating behaviour might be more realistic for Dutch school-based nutrition education programmes than changing their actual eating behaviour [18, 31].

Not being able to achieve improvements in children's actual eating behaviour, however, does not mean that school-based nutrition education is an insignificant investment. Some people argue that nutrition education should be part of children's general education, with the aim of providing them with essential knowledge and skills as in other subjects [18, 32]. Behavioural change theories, such as the Social Cognitive Theory, predict that knowledge is a precondition for behavioural change [31]. It was found that children with higher knowledge about the recommended daily intake and higher self-efficacy were more likely to eat more vegetables per day [34]. Childhood is a crucial period of life in which children begin to learn about food, and a lack of food literacy may contribute to unhealthy food choices later in life [35]. Therefore, increasing children's knowledge and skills on food and nutrition might still pay off in the future [33]. Also, children are the citizens of the future and need to be able not only to make healthy and conscious food choices for themselves, but also to make decisions about food

and environment issues in general [9, 36]. Primary schools play a crucial role in this by providing children with the necessary knowledge and skills to become food literate world citizens [9, 18, 36].

However, although nutrition knowledge has the potential to improve children's eating behaviour and therefore should be an essential target for health education [34, 35], a more integral approach is needed to achieve actual behavioural change. Increasing children's knowledge and skills can lead to (immediate) behavioural change only when children have the opportunity and are being stimulated to perform the desired behaviour at school, at home, and in other environments. Also, from a pedagogic point of view, messages sent to children should be consistent: in what they are taught, in what they see their parents, teachers, classmates, and friends doing, and in what the environment stimulates them to do [37]. Besides, behaviour does not only result from rational motives, but also from habits, preferences, and cues in the environment [38]. Therefore, complementing or extending nutrition education with other interventions, such as parental involvement, school nutrition policy, and environmental changes, might be needed to achieve sustained healthy eating behaviour.

The added effectiveness of extra experiential learning activities

The results of the second evaluation showed that adding experiential learning activities to the Taste Lessons programme further increased the intervention's effectiveness on children's knowledge. Also, the extended format showed significantly higher increases in children's cooking self-efficacy than Taste Lessons only (*chapter four*). Other studies comparing lessons only with lessons with additional gardening activities and/or cooking activities have also observed stronger intervention effects on children's knowledge and self-efficacy [9, 13, 20, 39]. The literature suggests that experiential learning activities are among the most promising methods for effective nutrition education [26, 40-42], as children's knowledge is best constructed from concrete experiences [9]. That is, children who actively apply concepts learn more and at a deeper level [43].

Besides, the participating children highly enjoyed the experiential learning methods. The results of our studies showed that children mostly liked the hands-on activities, such as tasting, cooking, and conducting experiments (*chapters three and six*). Similar findings were observed in process evaluations of other school-based nutrition education programmes [10, 44-48]. Moreover, children's enthusiasm about Taste Lessons was positively associated with changes in the programme outcomes (*chapters three and six*); this was also found in other studies [5, 15, 49, 50]. The success of experiential learning methods may therefore also originate from the fun children have and the positive associations they acquire with foods as a result of this [51]. The literature suggests that interest

increases learning, because promoting interest increases intrinsic motivation to learn [43]. In turn, interest may increase active learning as well [43]. Therefore, maintaining interest and including active participation may be the most important characteristics of effective nutrition education [9, 52].

Implications for practice and policy

The results of our studies prompt several recommendations for people working with school-based nutrition education programmes: policymakers, intervention developers, and teachers.

First, our results indicated that, with an average of about five lessons of Taste Lessons, small effects on knowledge and other psychosocial determinants can be achieved. More intensive implementation of school-based nutrition education in subsequent years might result in stronger effects. However, teachers in our studies mentioned that their time and budget for nutrition education were limited and often resulted in incomplete implementation of the Taste Lessons programme (*chapters three and six*, Table 1). Teachers have to deal with a busy curriculum [30, 53, 54], and nutrition education, which is often optional, can therefore be easily skipped. To increase dose, inclusion of nutrition as a mandatory part of the curriculum is recommended. If nutrition education remains optional, schools and teachers need to acknowledge the relevance of paying attention to nutrition education and should be convinced that they can contribute to improving children's health by implementing nutrition education programmes [55]. The results suggests that teachers who participated in the intervention groups were highly motivated to implement Taste Lessons. Therefore, increasing the perceived relevance of providing nutrition education might increase the implementation of programmes such as Taste Lessons.

Second, dose might be increased if nutrition education programmes offered several options for implementation, to make sure the programme was feasible to implement in all types of educational philosophies (e.g. Montessori and Dalton education). Implementation could be tailored to the needs and circumstances of the schools. Also, dose might be increased if nutrition education programmes could be implemented using a cross-curricular approach, meaning that lessons can be implemented across two or more traditional primary school subjects [18, 42].

Third, to implement experiential learning activities like those in Taste Lessons, teachers need a budget to buy food products. However, budgets for these kinds of activities are mostly scarce. In order to reduce financial obstacles for teachers, local implementation opportunities might help, such as cooperation with local food organisations and municipalities. For example, local business

models could be developed to financially support schools, or schools might take advantage of subsidies for the implementation of nutrition education.

Fourth, the literature suggests that teachers implement more programme activities when they receive training to increase their motivation and self-efficacy for implementing a nutrition education programme [56, 57]. Britten et al. found that knowledge of the subject and the programme were associated with the time teachers spent on teaching a subject [56]. The results of our second study showed that teachers were moderate about their perceived knowledge and skills to implement nutrition education, and that this self-efficacy was correlated with children's perceived norm of their teacher to eat healthily (*chapter six*). Although teachers' self-efficacy and attendance at the kick-off session were not associated with changes in the programme outcomes, programme developers are recommended to organise training or an introduction to the programme for the teachers. During these workshops, the programme materials can be explained, and teachers can be advised on how implementation of the programme creates optimal effect. Moreover, the effectiveness of nutrition education can be optimised if knowledge and skills regarding nutrition education are included in the curricula of training programmes for primary school teachers (in the Netherlands: Pabo).

Fifth, reminding teachers about the programme might enhance the continued implementation of its activities in subsequent periods or years. For example, teachers could be reminded by sending them periodic newsletters and organising special events. Updating lesson materials and activities might also help. Furthermore, implementation of nutrition education programmes might be enhanced by the use of modern methods, such as games or web-based activities [41, 42].

Sixth, guest lessons could be organised to relieve teachers and provide children with experiences from practice. The results of our studies showed that the cooking lesson was the most skipped lesson, because this lesson requires extra preparation time and organisation (*chapters three and four*). Organising guest lessons, for example cooking lessons provided by a dietician, might enhance implementation of lessons that are difficult or time-consuming for the teachers to implement [55]. Besides, teachers and children highly appreciated the cooking lesson with the dietician (*chapter four*). Guest lessons might therefore increase not only dose, but also programme appreciation. Finally, guest lessons may be a fruitful way to involve parents, as parents may be interested in learning about healthy eating behaviour from a dietician.

Seventh, in addition to increasing dose, the content of nutrition education programmes could be improved to enhance its effectiveness. The results of our studies indicated that children most liked the experience-oriented activities and that children's appreciation was positively associated with effect on the programme outcomes (*chapters three and six*; Table 1). Also, Taste Lessons with extra experiential learning activities showed more and stronger effects than implementation of Taste Lessons only (*chapter four*; Table 1). These results indicate that experiential learning activities, and other activities that children highly like, have the potential to enhance the effectiveness of school-based nutrition education [9].

Eighth, a closer involvement of children's home environment might enhance effectiveness, as this environment plays a key role in the development of children's healthy eating behaviour. The results of our second study showed that parents were positive about nutrition education, and their attitude was correlated with their child's psychosocial determinants of vegetables consumption. Parental involvement in the programme activities of Taste Lessons Vegetable Menu (extended format of Taste Lessons) did not show consistent associations with children's changes in the programme outcomes, but the number of parents that helped with an activity (18%) or attended the cooking session (37%) was fairly low (*chapter six*). Many other programmes have reported low levels of parental involvement [41, 58, 59], with one-third to half of the parents participating in any intervention activity [59]. Reinaerts et al. [46] found that parents were in favour of activities to promote fruit and vegetable consumption at school and would appreciate being informed about such activities, but did not want to participate. Therefore, school-based nutrition education should try to find effective ways of involving children's parents when attempting to improve children's eating behaviours.

Finally, it is recommended to use school-based nutrition education as part of a wider approach to improving children's eating behaviour. For example, nutrition education programmes could be combined with school policy on healthy nutrition. Regional public health organisations, municipalities, and organisations for environmental education could advise schools on adopting healthy eating behaviour policies. Initiatives such as Gezonde School (Healthy School), Jeugdimpuls, Jongeren op Gezond Gewicht (JOGG: Youth at a Healthy Weight), and local initiatives might provide support with budgets, networks, and advice on appropriate policies and programmes. In a broader approach, school-based nutrition education in combination with other interventions and environmental changes might provide enough stimuli to achieve sustained behavioural change [23, 60, 61].

Suggestions for further research

The results of our studies have contributed to the knowledge and the potential to improve the effectiveness of school-based nutrition education, but future research is needed to confirm our findings and further explore whether its effectiveness can be enhanced.

The results of our studies indicated that on average five lessons of the Taste Lessons programme, both with and without additional experiential learning activities, increased children's knowledge and several other determinants of healthy eating behaviour, but was not intensive enough to induce high and sustained changes in behavioural determinants and behaviour (*chapters two, four, and five*; Table 1). These results suggest that a more intensive exposure to school-based nutrition education might induce stronger effects. However, associations between dose and change in the programme outcomes did not show a consistent dose–response relationship (*chapters three and six*; Table 1). Therefore, research is needed to demonstrate at what dose there might be a threshold to achieve desired effects.

The results of this thesis are based on studies conducted in grades 5–8 of Dutch primary schools. However, Taste Lessons is a programme for grades 1–8 of primary schools. It would be interesting to measure also the effectiveness of Taste Lessons in children in primary school grades 1–4. Correspondingly, it would be interesting to investigate whether repeated exposure (for example yearly exposure to Taste Lessons in all primary school grades) induces higher effects than exposure to Taste Lessons in a single year.

Another strategy to increase the effectiveness of school-based nutrition education might be to use nutrition education programmes in combination with other interventions, for example, school policy on healthy snacks and treats, more intensive parental involvement, and physical changes in the children's environments. Few studies have investigated the added effectiveness of nutrition education with other interventions in and around primary schools [23, 60, 61]. Therefore, it would be interesting to investigate whether a combination of school-based nutrition education programmes with other interventions in a multiple component approach (for example JOGG) achieves higher effects on psychosocial determinants and actual behavioural change.

Our results suggest that experiential learning methods might be one of the most effective components in Taste Lessons. Children most liked these activities in Taste Lessons, and their programme appreciation was positively associated with changes in the programme outcomes (*chapter three*; Table 1). Also, our results indicated that adding experiential learning activities to the Taste Lessons

programme resulted in more and stronger effects on determinants of vegetable consumption than Taste Lessons alone (*chapter four*). However, we were not able to identify the added value per hands-on activity, and whether one of the activities or a combination of these activities resulted in stronger intervention effects. Therefore, more research should be conducted on the effective components in nutrition education programmes. Also, it would be interesting for future research to further explore the potential of other types of experiential learning activities in school-based nutrition education.

Finally, it would be interesting to explore the best circumstances in which to implement nutrition education to enhance its effectiveness, for example, how the school environment, teachers' teaching methods, and parental involvement are associated with the effectiveness of school-based nutrition education. In chapter six, we measured with questionnaires whether several teacher-related factors influenced children's changes in the programme outcome measures, but this showed little variation in the factors. Observation methods to measure teachers' behaviour during the lessons might obtain more objective results.

Overall conclusion

In conclusion, evaluation of the Dutch school-based nutrition education programme Taste Lessons has shown that the programme increased children's knowledge and several other psychosocial determinants of healthy eating behaviour. Implementation of (additional) experiential learning methods in school-based nutrition education is likely to enhance its effectiveness, as children mostly liked these activities, and children's enthusiasm was the strongest predictor of effectiveness. No effects were found on children's vegetable consumption; this might be explained by the low intensity of the programme and children's dependence on their parents' food choices. To achieve behavioural change, school-based nutrition education should be complemented with a consistent set of changes in children's environment.

References

1. Ajzen I, Fishbein M. Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice-Hall; 1980.
2. Fishbein M, Triandis HC, Kanfer FH, Becker M, Middlestadt SE. Factors influencing behavior and behavior change. In: A. Baum TRR, Singer JE, editors. Handbook of Health Psychology. Mahwah, NJ: Erlbaum; 2001. pp. 3-17.
3. Riebl SK, Estabrooks PA, Dunsmore JC, Savla J, Frisard MI, Dietrich AM, et al. A systematic literature review and meta-analysis: the Theory of Planned Behavior's application to understand and predict nutrition-related behaviors in youth. Eat Behav. 2015;18:160-78.
4. Boluijt P, Van Oord-Jansen S. Evaluatierapport "De Gezonde HAP&STAP Vierdaagse" - Resultaten kalenderjaar 2011. Apeldoorn: Evaluatiebureau Publieke Gezondheid - Onderdeel van GGD Gelre-IJssel/Academische Werkplaats AGORA; 2012.
5. Tak NI, te Velde SJ, Brug J. Long-term effects of the Dutch Schoolgruiten Project–promoting fruit and vegetable consumption among primary-school children. Public Health Nutrition. 2009;12(08):1213-23.
6. Wall DE, Least C, Gromis J, Lohse B. Nutrition education intervention improves vegetable-related attitude, self-efficacy, preference, and knowledge of fourth-grade students. Journal of School Health. 2012;82(1):37-43.
7. Baranowski T, Davis M, Resnicow K, Baranowski J, Doyle C, Lin LS, et al. Gimme 5 fruit, juice, and vegetables for fun and health: outcome evaluation. Health Education & Behavior. 2000;27(1):96-111.
8. Keihner AJ, Meigs R, Sugerman S, Backman D, Garbolino T, Mitchell P. The power play! Campaign's school idea & resource kits improve determinants of fruit and vegetable intake and physical activity among fourth- and fifth-grade children. Journal of Nutrition Education and Behavior. 2011;43(4, Supplement 2):S122-S9.
9. Liquori T, Koch PD, Contento I, Castle J. The cookshop program: outcome evaluation of a nutrition education program linking lunchroom food experiences with classroom cooking experiences. Journal of Nutrition Education. 1998;30(5):302-13.
10. Reynolds KD, Franklin FA, Binkley D, Raczynski JM, Harrington KF, Kirk KA, et al. Increasing the fruit and vegetable consumption of fourth-graders: results from the High 5 project. Preventive Medicine. 2000;30(4):309-19.
11. Auld GW, Romaniello C, Heimendinger J, Hambidge C, Hambidge M. Outcomes from a school-based nutrition education program using resource teachers and cross-disciplinary models. Journal of Nutrition Education. 1998;30(5):268-80.
12. Morris JL, Zidenberg-Cherr S. Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. Journal of the American Dietetic Association. 2002;102(1):91-3.
13. Prelip M, Kinsler J, Thai CL, Erausquin JT, Slusser W. Evaluation of a school-based multicomponent nutrition education program to improve young children's fruit and vegetable consumption. Journal of Nutrition Education and Behavior. 2012;44(4):310-18.
14. DelCampo D, Baca JS, Jimenez D, Sánchez PR, DelCampo R. Just be it! Healthy and fit increases fifth graders' fruit and vegetable intake, physical activity, and nutrition knowledge. Journal of Extension. 2011;49(1).
15. Bere E, Veierød MB, Bjelland M, Klepp K-I. Outcome and process evaluation of a Norwegian school-randomized fruit and vegetable intervention: Fruits and Vegetables Make the Marks (FVMM). Health Education Research. 2006;21(2):258-67.
16. Anderson A, Porteous L, Foster E, Higgins C, Stead M, Hetherington M, et al. The impact of a school-based nutrition education intervention on dietary intake and cognitive and attitudinal variables relating to fruits and vegetables. Public Health Nutrition. 2005;8(06):650-6.
17. Bontrager Yoder AB, Liebhart JL, McCarty DJ, Meinen A, Schoeller D, Vargas C, et al. Farm to elementary school programming increases access to fruits and vegetables and increases their consumption among those with low intake. Journal of Nutrition Education and Behavior. 2014;46(5):341-9.
18. Contento IR, Manning AD, Shannon B. Research perspective on school-based nutrition education. Journal of Nutrition Education. 1992;24(5):247-60.
19. Reverdy C, Chesnel F, Schlich P, Köster EP, Lange C. Effect of sensory education on willingness to taste novel food in children. Appetite. 2008;51(1):156-65.

20. Morgan PJ, Warren JM, Lubans DR, Saunders KL, Quick GI, Collins CE. The impact of nutrition education with and without a school garden on knowledge, vegetable intake and preferences and quality of school life among primary-school students. Public Health Nutrition. 2010;13(11):1931-40.
21. Jones M, Dailami N, Weitkamp E, Salmon D, Kimberlee R, Morley A, et al. Food sustainability education as a route to healthier eating: evaluation of a multi-component school programme in English primary schools. Health Education Research. 2012;27(3):448-58.
22. McAleese JD, Rankin LL. Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. Journal of the American Dietetic Association. 2007;107(4):662-5.
23. Wang MC, Rauzon S, Studer N, Martin AC, Craig L, Merlo C, et al. Exposure to a comprehensive school intervention increases vegetable consumption. Journal of Adolescent Health. 2010;47(1):74-82.
24. Chen Q, Goto K, Wolff C, Bianco-Simeral S, Gruneisen K, Gray K. Cooking up diversity. Impact of a multicomponent, multicultural, experiential intervention on food and cooking behaviors among elementary-school students from low-income ethnically diverse families. Appetite. 2014;80(0):114-22.
25. Mustonen S, Rantanen R, Tuorila H. Effect of sensory education on school children's food perception: a 2-year follow-up study. Food Quality and Preference. 2009;20(3):230-40.
26. Knai C, Pomerleau J, Lock K, McKee M. Getting children to eat more fruit and vegetables: a systematic review. Preventive Medicine. 2006;42(2):85-95.
27. Contento IR. Nutrition education: linking research, theory, and practice. Burlington, MA: Jones & Barlett Learning; 2007.
28. Evans CE, Christian MS, Cleghorn CL, Greenwood DC, Cade JE. Systematic review and meta-analysis of school-based interventions to improve daily fruit and vegetable intake in children aged 5 to 12 y. The American Journal of Clinical Nutrition. 2012;96(4):889-901.
29. Brug J, Tak NI, te Velde SJ, Bere E, de Bourdeaudhuij I. Taste preferences, liking and other factors related to fruit and vegetable intakes among schoolchildren: results from observational studies. British Journal of Nutrition. 2008;99(SupplementS1):S7-S14.
30. Thijssen J, Schoot Fvd, Hemker B. Balans van het biologieonderwijs aan het einde van de basisschool 4 - Extra aandachtsgebied Voeding en gezondheid - Uitkomsten van de vierde peiling in 2010. Periodieke Peiling van het Onderwijsniveau. 2011.
31. Vaitkeviciute R, Ball LE, Harris N. The relationship between food literacy and dietary intake in adolescents: a systematic review. Public Health Nutrition. 2015;18(04):649-58.
32. Voedselvaardigheden op school. Den Haag: Nationaal Programma Preventie Alles is gezondheid...; 2015.
33. EU Action Plan on Childhood Obesity 2014–2020. Brussels, Belgium; 2014. http://ec.europa.eu/health/nutrition_physical_activity/docs/childhoodobesity_actionplan_2014_2020_en.pdf
34. Lotrean LM, Tutui I. Individual and familial factors associated with fruit and vegetable intake among 11- to 14-year-old Romanian school children. Health Soc Care Community. 2015;23(5):541-9.
35. Grosso G, Mistretta A, Turconi G, Cena H, Roggi C, Galvano F. Nutrition knowledge and other determinants of food intake and lifestyle habits in children and young adolescents living in a rural area of Sicily, South Italy. Public Health Nutrition. 2013;16(10):1827-36.
36. Ensaff H, Canavon C, Crawford R, Barker M. A qualitative study of a food intervention in a primary school: pupils as agents of change. Appetite. 2015;95:455-65.
37. de Wit C. Opvoeden doe je samen - Samenwerking tussen professionals en ouders. De wereld van het jonge kind. 2003(6 (+ Spelend leren Katern 48)).
38. Kremers SP, de Bruijn GJ, Visscher TL, van Mechelen W, de Vries NK, Brug J. Environmental influences on energy balance-related behaviors: a dual-process view. Int J Behav Nutr Phys Act. 2006;3:9.
39. Robinson-O'Brien R, Story M, Heim S. Impact of garden-based youth nutrition intervention programs: a review. Journal of the American Dietetic Association. 2009;109(2):273-80.
40. Peters LWH, Kok G, Ten Dam GTM, Buijs GJ, Paulussen TGWM. Effective elements of school health promotion across behavioral domains: a systematic review of reviews. BMC Public Health. 2009;9:182.
41. Pérez-Rodrigo C, Aranceta J. School-based nutrition education: lessons learned and new perspectives. Public Health Nutrition. 2001;4(1A):131-9.

42. Dudley DA, Cotton WG, Peralta LR. Teaching approaches and strategies that promote healthy eating in primary school children: a systematic review and meta-analysis. Int J Behav Nutr Phys Act. 2015;12:28.
43. Schraw G, Flowerday T, Lehman S. Increasing situational interest in the classroom. Educational Psychology Review. 2001;13(3):211-24.
44. van der Horst K, Ferrage A, Rytz A. Involving children in meal preparation. Effects on food intake. Appetite. 2014;79(0):18-24.
45. Heim S, Stang J, Ireland M. A garden pilot project enhances fruit and vegetable consumption among children. Journal of the American Dietetic Association. 2009;109(7):1220-6.
46. Reinaerts E, Nooijer Jd, Kar Avd, Vries Nd. Development of a school-based intervention to promote fruit and vegetable consumption: exploring perceptions among 4- to 12-year old children and their parents. Health Education. 2006;106(5):345-56.
47. Steckler A, Ethelbah B, Martin CJ, Stewart D, Pardilla M, Gittelsohn J, et al. Pathways process evaluation results: a school-based prevention trial to promote healthful diet and physical activity in American Indian third, fourth, and fifth grade students. Preventive Medicine. 2003;37, Supplement 1(0):S80-S90.
48. Davis M, Baranowski T, Resnicow K, Baranowski J, Doyle C, Smith M, et al. Gimme 5 fruit and vegetables for fun and health: process evaluation. Health Educ Behav. 2000;27(2):167-76.
49. Wind M, Bjelland M, Pérez-Rodrigo C, te Velde SJ, Hildonen C, Bere E, et al. Appreciation and implementation of a school-based intervention are associated with changes in fruit and vegetable intake in 10- to 13-year old schoolchildren—the Pro Children study. Health Education Research. 2008;23(6):997-1007.
50. te Velde SJ, Wind M, van Lenthe FJ, Klepp KI, Brug J. Differences in fruit and vegetable intake and determinants of intakes between children of Dutch origin and non-Western ethnic minority children in the Netherlands - a cross sectional study. The International Journal of Behavioral Nutrition and Physical Activity. 2006;3:31.
51. Dazeley P, Houston-Price C, Hill C. Should healthy eating programmes incorporate interaction with foods in different sensory modalities? A review of the evidence. British Journal of Nutrition. 2012;108(05):769-77.
52. Cheng FW, Monnat SM, Lohse B. Middle school-aged child enjoyment of food tastings predicted interest in nutrition education on osteoporosis prevention. Journal of School Health. 2015;85(7):467-76.
53. Martens M, Sluis Mvd. Smaaklessen - Een procesevaluatie onder docenten, leerlingen, partners en Regionale steunpunten. Amsterdam: ResCon, research & consultancy; 2011.
54. Bonell C, Humphrey N, Fletcher A, Moore L, Anderson R, Campbell R. Why schools should promote students' health and wellbeing. BMJ. 2014; 348.
55. Friend S, Flattum CF, Simpson D, Nederhoff DM, Neumark-Sztainer D. The researchers have left the building: what contributes to sustaining school-based interventions following the conclusion of formal research support? Journal of School Health. 2014;84(5):326-33.
56. Britten P, Lai MK. Structural analysis of the relationships among elementary teachers' training, self-efficacy, and time spent teaching nutrition. Journal of Nutrition Education. 1998;30(4):218-24.
57. Stang J, Story M, Kalina B. Nutrition education in Minnesota public schools: perceptions and practices of teachers. Journal of Nutrition Education. 1998;30(6):396-404.
58. Blanchette L, Brug J. Determinants of fruit and vegetable consumption among 6–12-year-old children and effective interventions to increase consumption. Journal of Human Nutrition and Dietetics. 2005;18(6):431-43.
59. Langford R, Bonell C, Jones H, Campbell R. Obesity prevention and the health promoting schools framework: essential components and barriers to success. International Journal of Behavioral Nutrition and Physical Activity. 2015;12(1):1-17.
60. Mikkelsen BE. School – a multitude of opportunities for promoting healthier eating. Public Health Nutrition. 2014;17(06):1191-4.
61. Birnbaum AS, Lytle LA, Story M, Perry CL, Murray DM. Are differences in exposure to a multicomponent school-based intervention associated with varying dietary outcomes in adolescents? Health Education & Behavior. 2002;29(4):427-43

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Summary

Healthy eating behaviour in childhood is important for children's growth and development and might protect against the development of obesity and chronic diseases later in life. The school environment provides an effective setting for teaching children about nutrition and healthy eating behaviour. Therefore, school-based nutrition education programmes have increasingly been used in the past few decades to teach children about nutrition and to provide them with the skills to make healthy food choices. However, evaluating these programmes is complex, and studies have shown varying effects. As the programmes differ in content and delivery, it is hard to identify what intervention components and implementation conditions are most effective. Furthermore, as nutrition education is not mandatory in the Netherlands, it is not clear what effects can be achieved with school-based nutrition education in Dutch primary schools.

To investigate the implementation and the effectiveness of nutrition education in Dutch primary schools, two process and effect evaluations were conducted on the school-based nutrition education programme Taste Lessons. Taste Lessons (Smaaklessen) is a practice-driven programme on taste development, healthy nutrition, and food quality for grades 1–8 (children aged 4–12 years). The programme was developed in 2006 by the Netherlands Nutrition Centre and Wageningen University, and more than a third of all primary schools have registered for the programme. The effectiveness of this programme was measured on its aims to increase children's interest in food, and their knowledge and skills regarding healthy and conscious eating behaviour, by measuring changes in children's psychosocial determinants of eating behaviour. In addition, effectiveness was measured on behavioural outcomes. Moreover, the influence of adding experiential learning activities and implementation factors on effectiveness are addressed. The main findings of this research project as described in chapters two to six are summarised below.

In school year 2011–2012, an effect and process evaluation of Taste Lessons was conducted in which teachers implemented the first version of Taste Lessons, consisting of 10–12 lessons per every two grades. In this quasi-experimental study, 1183 children in grades 5–8 of 21 schools participated in an intervention or a control group by filling out questionnaires on psychosocial determinants before the programme, and at one month and six months after it. Children and their teachers in the intervention group also completed a questionnaire to evaluate programme delivery and programme appreciation.

The results of this study showed that partial implementation of the programme during one school year resulted in small effects on increasing psychosocial determinants of tasting unfamiliar foods and eating healthily and a variety of foods (*chapter two*). After four weeks, the intervention group showed a higher

increase in subjective norm of the teacher and intention towards the target behaviours, and number of foods known and tasted (all d=0.2, p<0.05). The highest increase was observed in children's knowledge (d=0.3, p<0.01), which still persisted six months after the programme (d=0.2, p<0.05).

In school-year 2013–2014, an effect and process evaluation of an adapted version of Taste Lessons was conducted. In this adapted version, the 10–12 lessons per every two grades were re-arranged into five lessons per grade. The design of this study was similar to that of the first study, and it was conducted in 1010 children in grades 5–8 in 34 schools. In this study, the intervention group was divided in two: children who received the Taste Lessons Vegetable Menu (Taste Lessons with additional experiential learning activities in a vegetable project) and children receiving the five lessons of Taste Lessons only. Children in the intervention and the control groups completed a questionnaire on psychosocial determinants of vegetable consumption, actual daily vegetable consumption, and food neophobia before and after Taste Lessons. Also, the children took part in a taste test to more objectively assess their willingness to taste unfamiliar vegetables. Moreover, children, their parents, and the teachers in the intervention group completed a questionnaire on implementation factors regarding nutrition education and the Taste Lessons programme.

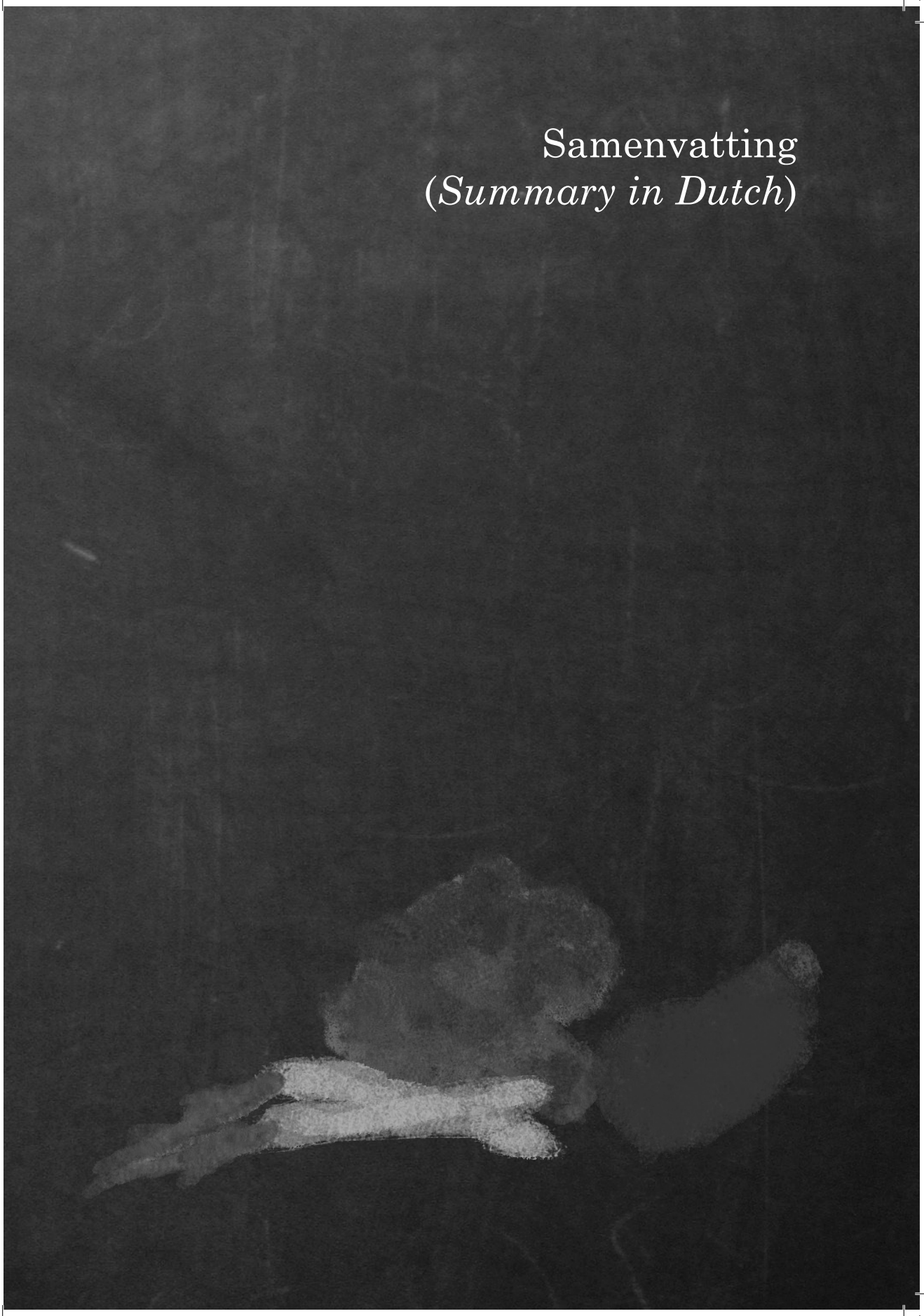
The results from this second study showed that the five lessons of Taste Lessons were almost completely implemented by the teachers, and the effects on the psychosocial determinants were similar to those in the first study (*chapter four*). Again, the strongest intervention effect was found on knowledge: children in the Taste Lessons group showed a significantly higher increase in knowledge compared to the control group (d=0.4, p<0.001). Additional experiential learning activities in the Taste Lessons Vegetable Menu, such as an extended cooking lesson with a dietician and the parents, an excursion to a grower, and a supermarket assignment, showed more and stronger increases in several psychosocial determinants of vegetable consumption than Taste Lessons without these additional activities. The Taste Lessons Vegetable Menu showed a significantly higher increase in knowledge (d=0.5, p<0.001), attitude, and subjective norm of the teacher (both d=0.2, p<0.05) than the control group, and a higher increase in knowledge, subjective norm of the teacher (both d=0.2, p<0.10), and cooking self-efficacy (d=0.2, p<0.05) than the Taste Lessons only group. No significant intervention effects were found on children's willingness to taste unfamiliar vegetables during a taste test, nor on their daily vegetable consumption and food neophobia (*chapter five*).

Analyses of the process indicators in both studies revealed that teachers, parents, and children highly liked Taste Lessons and that children most liked

the experiential learning activities (*chapters three and six*). Furthermore, children's programme appreciation and interpersonal communication about the programme activities were found to be positively associated with the changes in the psychosocial determinants of the target behaviours.

In conclusion, evaluation of the Dutch school-based nutrition education programme Taste Lessons showed an increase in children's knowledge and several other psychosocial determinants of eating behaviour. Implementation of (additional) experiential learning methods in school-based nutrition education is likely to enhance the intervention's effectiveness, as children mostly liked these activities and children's enthusiasm was the strongest predictor of effectiveness. No effects were found on children's vegetable consumption. This might be explained by the low intensity of the programme and children's dependence on their parents' food choices. To achieve behavioural change, school-based nutrition education should be complemented with a consistent set of changes in children's environment.

Samenvatting
(*Summary in Dutch*)



Gezond eetgedrag bij kinderen is belangrijk voor hun groei en ontwikkeling. Daarnaast beschermt het hen tegen de ontwikkeling van overgewicht en chronische ziekten op latere leeftijd. De school is een geschikte omgeving voor het onderwijzen van kinderen in voeding en gezond eetgedrag. Daarom wordt voedingseducatie op basisscholen steeds vaker aangeboden om kinderen kennis en vaardigheden bij te brengen om gezonde en bewuste voedselkeuzes te maken. Het evalueren van lesprogramma's is echter complex en studies laten wisselende effecten zien. Het is bovendien niet duidelijk welke effecten bereikt kunnen worden met voedingseducatie in Nederland, omdat het geen verplicht onderdeel is van het curriculum in het basisonderwijs.

Om de implementatie en effectiviteit van voedingseducatie in het Nederlandse basisonderwijs te onderzoeken, zijn evaluatiestudies uitgevoerd naar twee versies van het lesprogramma Smaaklessen. Smaaklessen is een nationaal lesprogramma over smaakontwikkeling, gezonde voeding en voedselkwaliteit voor groep 1-8 van de basisschool, ontwikkeld door het Voedingscentrum en de Wageningen Universiteit. Sinds de start in 2006 heeft ruim een derde van alle basisscholen zich voor het programma ingeschreven. In het onderzoek is het lesprogramma geëvalueerd op haar doelstelling om kinderen te interesseren in voedsel en hun kennis en vaardigheden ten aanzien van gezond en bewust eetgedrag te vergroten. Hieronder worden de uitkomsten van de twee evaluatiestudies beschreven waarbij het lesprogramma verschilt in het aantal aangeboden lessen en aanvullende activiteiten.

In het schooljaar 2011-2012 is een eerste effect- en procesevaluatie naar Smaaklessen uitgevoerd. In deze quasi-experimentele studie namen 1183 kinderen uit groep 5-8 van 21 scholen deel in een interventie- of controlegroep. Hierbij implementeerden leerkrachten in de interventiegroep de eerste versie van de Smaaklessen. Deze versie bestond uit 10-12 lessen per elke twee leerjaren. De leerkrachten in de controlegroep gaven geen voedingseducatie. Kinderen in beide onderzoeksgroepen vulden voorafgaand, en één maand en zes maanden na het programma een vragenlijst in over psychosociale factoren ten aanzien van onbekende producten proeven, gezond eten en letten op voedselkwaliteit. Kinderen en hun leraren in de interventiegroep vulden na het programma ook een vragenlijst in over hoe Smaaklessen was ingezet en hoe ze het programma waardeerden.

De resultaten van deze studie lieten zien dat een gedeeltelijke inzet van het programma gedurende een enkel schooljaar effectief was in het verhogen van enkele psychosociale factoren (*hoofdstuk twee*). Na een maand lieten kinderen in de interventiegroep namelijk een grotere stijging zien in hun subjectieve norm van de leraar en hun intentie ten aanzien van de doelgedragingen, en in

het aantal producten dat ze kenden en geproefd hadden (alle *d*=0,2, p<0,05). De grootste toename werd gemeten op het kennisniveau van de kinderen (*d*=0,3, p<0,01). Dit effect op kennis was ook zes maanden na het programma nog aanwezig (*d*=0,2, p<0,05).

In het schooljaar 2013-2014 is vervolgens een effect- en procesevaluatie naar de aangepaste versie van Smaaklessen uitgevoerd. In deze aangepaste versie waren de 10-12 lessen per twee leerjaren aangepast naar vijf lessen per leerjaar. De opzet van deze studie was vergelijkbaar met die van de eerste studie en werd dit keer uitgevoerd bij 1010 kinderen in groep 6-7 van 34 basisscholen. De interventiegroep werd hierbij in tweeën gedeeld: kinderen die het 'Smaaklessen groentemenu' ontvingen (Smaaklessen met extra ervaringsgerichte activiteiten in een groenteproject) en kinderen die alleen de vijf lessen van Smaaklessen kregen. Kinderen in de interventiegroepen en controlegroep vulden voorafgaand en na afloop van het programma een vragenlijst in over psychosociale factoren ten aanzien van hun groenteconsumptie. Ook bevatte de vragenlijst dit keer vragen over hun werkelijke dagelijkse groenteconsumptie en over voedselneofobie (angst om onbekend voedsel te proeven). Daarnaast namen de kinderen deel aan een smaaktest om op een meer objectieve manier hun bereidheid om onbekende groenten te proeven te meten. Ten slotte vulden kinderen, hun ouders en de leerkrachten in de interventiegroepen voor en na het programma een vragenlijst in over voedingseducatie, hoe Smaaklessen was ingezet en hoe ze het programma waardeerden.

De resultaten van deze tweede studie toonden aan dat de vijf lessen van Smaaklessen bijna volledig werden ingezet door de leraren en dat de effecten op de psychosociale factoren vergelijkbaar waren met die in de eerste studie (*hoofdstuk vier*). Opnieuw werd het sterkste effect gevonden op kennis: kinderen in de Smaaklessengroep lieten een significant hogere stijging in hun kennisniveau zien dan de controlegroep (*d*=0,4, p<0,001). De toevoeging van extra ervaringsgerichte activiteiten in het 'Smaaklessen groentemenu', zoals een uitgebreide kookles met een diëtist en de ouders, een excursie naar een kweker, en een supermarktopdracht, liet meer en sterkere stijgingen in verschillende psychosociale factoren van groenteconsumptie zien dan Smaaklessen zonder deze extra activiteiten. Kinderen in de Smaaklessen groentemenu groep lieten een significant hogere stijging zien in kennis (*d*=0,5, p<0,001), attitude en subjectieve norm van de leraar (beide *d*=0,2, p<0,05) dan de controlegroep, en een sterkere stijging in kennis, subjectieve norm van de leraar (beide *d*=0,2, p<0,10) en kookvaardigheden (*d*=0,2, p<0,05) dan de Smaaklessengroep. Er werden geen significante effecten gevonden op de bereidheid van kinderen om onbekende groenten te proeven tijdens een smaaktest, en ook niet op hun dagelijkse groenteconsumptie en voedselneofobie (*hoofdstuk vijf*).

Resultaten van de procesevaluaties van beide studies lieten zien dat leerkrachten, ouders en kinderen Smaaklessen zeer waardeerden. Kinderen vonden de ervaringsgerichte elementen het leukst (*hoofdstuk drie en zes*). Bovendien hing de waardering door kinderen en de mate waarin ze over Smaaklessen napraatten positief samen met de mate van verandering in psychosociale factoren.

De uitgevoerde onderzoeken toonden hiermee aan dat Smaaklessen het kennisniveau en diverse andere psychosociale factoren ten aanzien van gezond en bewust eetgedrag verhoogt. Het toevoegen van ervaringsgerichte methoden bleek veelbelovend om de effectiviteit van voedingseducatie in het basisonderwijs verder te verhogen. Kinderen vonden deze activiteiten het leukst en het enthousiasme van de kinderen bleek de sterkste voorspeller van de mate van effectiviteit. Er werden geen effecten gevonden op de groenteconsumptie van kinderen of andere gedragsuitkomsten. Dit kan mogelijk verklaard worden door de lage intensiteit van het programma en het feit dat de voedingsinname van kinderen afhankelijk is van de voedselkeuzes van hun ouders. Om gedragsverandering te bereiken, zal voedingseducatie in het Nederlandse basisonderwijs moeten worden aangevuld met een ondersteunend pakket van aanpassingen in de omgeving van de kinderen.

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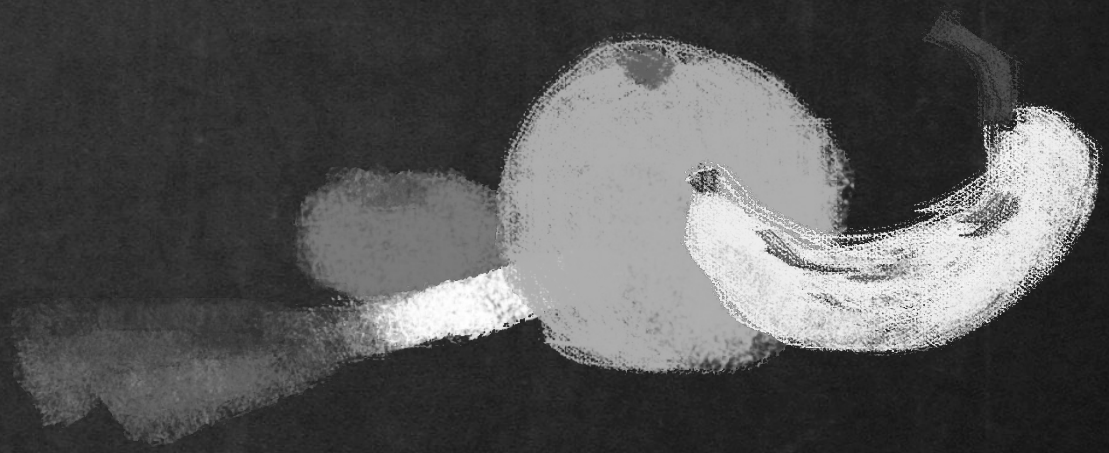
About the author



Curriculum vitae

Marieke Battjes-Fries was born on 29 June 1986 in Houten, The Netherlands. After completing secondary school at 'Cals College' in Nieuwegein, she started to study Nutrition and Health at Wageningen University in 2004, with specialisation Public Health Nutrition and Epidemiology. During her Masters she conducted a thesis at the National Institute for Public Health and the Environment (RIVM) on the association between overweight and school performance among Dutch children, and did an internship at the Netherlands Nutrition Centre (Voedingscentrum) where she developed and tested a questionnaire to assess children's eating behaviour for evaluation of the Dutch nutrition-education programme Taste Lessons (Smaaklessen). During her study, she was member of the education committee of the Division of Human Nutrition, the committee of grant application for student activities of Wageningen University, the board of a student organization and other committees. Besides, in side jobs she was appointed to support a MSC course at the Division of Human Nutrition of the Wageningen University, and to analyse data and write a report on the proces- and effect-evaluation of two local interventions to prevent or reduce obesity in children at the 'GGD Noord- en Oost-Gelderland' (former GGD Gelre-IJssel).

After obtaining her Master's degree in 2010, Marieke was appointed at the Netherlands Institute for Sport and Physical Activity (NISB) for half a year to conduct a qualitative evaluation of the four-year running national campaign '30minutenbewegen'. At the same time, she worked at the national coordination centre of Taste Lessons (Steunpunt Smaaklessen) at Wageningen University on the set-up of an effect-evaluation of Taste Lessons and supporting of students working on this project. In 2011, she continued working at the Wageningen University in the Division of Human Nutrition and conducted a larger proces- and effect-evaluation of Taste Lessons, financed by Ministry of Economic Affairs.

In 2013, Marieke's contract at Wageningen University was extended to work as PhD Candidate at the Division of Human Nutrition. During this PhD project, she conducted another proces- and effect-evaluation of Taste Lessons with and without additional experiential learning activities to look further at the effectiveness of nutrition education in Dutch primary schools. During this PhD project, she also evaluated implementation and effectiveness of 'Expeditie Lekker Fit!', a nutrition programme which was organised by the Municipality of Woudrichem, 'GGD West-Brabant' and 'HAK Groente Instituut' and implemented by six schools in Woudrichem for three subsequent years. Besides, she joined the education programme of the Graduate School VLAG, she attended several (international) conferences and courses, and was involved in teaching and supervising students at BSc and MSc level. Currently, Marieke is working as researcher Food Quality and Health at the Louis Bolk Institute.

List of Publications

Publications in peer-reviewed journals

- Battjes-Fries MCE, Wijnands-Minnema R, Dekker-Groen AM, van den Top-Pullen R, de Graaf K, van 't Veer P, Haveman-Nies A. Associations between school, teacher, parent and child related implementation factors and effectiveness of the Dutch school-based nutrition education programme Taste Lessons. Submitted. 2015.
- Battjes-Fries MCE, Haveman-Nies A, Zeinstra GG, van Dongen EJI, Meester HJ, van den Top-Pullen R, van 't Veer P, de Graaf K. Effectiveness of Taste Lessons with and without extra experiential learning activities on children's willingness to taste vegetables. Submitted. 2015.
- Battjes-Fries MCE, Haveman-Nies A, van Dongen EJI, Meester HJ, van den Top-Pullen R, de Graaf K, van 't Veer P. Effectiveness of Taste Lessons with and without additional experience-oriented activities on children's psychosocial determinants of vegetables consumption. Submitted. 2015.
- Battjes-Fries MCE, van Dongen EJI, Renes RJ, Meester HJ, van 't Veer P, Haveman-Nies A. Unravelling the effect of the Dutch school-based nutrition programme 'Taste Lessons': the role of dose, appreciation and interpersonal communication. Submitted. 2015.
- Battjes-Fries MCE, Haveman-Nies A, Renes RJ, Meester HJ, van 't Veer P. Effect of the Dutch school-based education programme 'Taste Lessons' on behavioural determinants of taste acceptance and healthy eating: a quasi-experimental study. Public Health Nutrition. 2015; 18(12):2231-2241.
- Veldwijk J, Fries MCE, Bemelmans WJE, Haveman-Nies A, Smit HA, Koppelman GH, Wijga AH. Overweight and school performance among primary school children: The PIAMA birth cohort study. Obesity. 2012; 20(3): 590-596.

Abstracts in scientific journals or proceedings

- Battjes-Fries MCE, Haveman-Nies A, van Dongen EJI, Meester HJ, de Graaf K, van 't Veer P. Effectiveness of school-based nutrition programme Taste Lessons with and without experience-oriented activities on children's determinants of behaviour towards vegetable consumption: a quasi-experimental study. (Abstract for 14th Meeting of the International Society of Behavioral Nutrition and Physical Activity, Edinburgh, Scotland, 2015, oral presentation)
- Battjes-Fries MCE, Haveman-Nies A, Zeinstra GG, Meester HJ, van 't Veer P, de Graaf K. Effectiveness of school-based nutrition programme Taste Lessons on children's willingness to taste vegetables. (Abstract for 39th Annual Meeting of the British Feeding & Drinking Group, Wageningen, The Netherlands, 2015, poster presentation)
- van Dongen EJI, Battjes-Fries MCE, Renes RJ, van 't Veer P, Haveman-Nies A. Implementation factors as indicators for effect of the Dutch school-based nutrition program 'Taste Lessons'. European Journal of Public Health; 2013: 23 (suppl 1). (Abstract for the European Public Health Conference, Brussel, Belgium, 2013, oral presentation)
- Fries MCE, Hiemstra A, van Rijn J. Evaluatieonderzoek 4 jaar campagnevoeren 30minutenbewegen. (Abstract for Nederlands Congres Volksgezondheid, Amsterdam, The Netherlands, 2011, poster presentation)

Publications in a journal

- Fries MCE, Veldwijk J, Haveman-Nies A, Bemelmans WJE, Wijga AH. Onderzoek naar de inhoud van lunchtrommels. Voeding Nu. 2011; 3: 14-16.

Reports

- M Groothuis, MCE Battjes-Fries, A Haveman-Nies (2015). Evaluatie en borging van Smaaklessen met aanvullende activiteiten - Het Smaaklessen groentemenu onderzoek. Wageningen UR, Leerstoelgroep Humane Voeding.
- MCE Battjes-Fries, EJI van Dongen, A Haveman-Nies (2013). Evaluatie van Smaaklessen: heeft Smaaklessen effect op determinanten van gezond en bewust eetgedrag? Wageningen UR, Leerstoelgroep Humane Voeding.
- MCE Battjes-Fries, A Haveman-Nies, RJ Renes (2012). Evaluatie van Smaaklessen: heeft Smaaklessen effect op kennis over voedsel en interesse in het proberen van onbekende producten? Wageningen UR, Leerstoelgroep Humane Voeding.
- Fries, MCE & van Oord-Jansen S (2010). Evaluatierapport "De Gezonde HAP&STAP Vierdaagse", resultaten kalenderjaar 2009. Academische Werkplaats AGORA, consortium van GGD Gelre-IJssel en Wageningen Universiteit.

Overview of completed training activities

Discipline specific activities

Conferences and meetings

- European Public Health Conference (EUPHA), Copenhagen, Denmark, 2011.
- Nederlands Congres Volksgezondheid (NCVGZ), Amsterdam, The Netherlands, 2012.
- Spring meeting Werkgroep Voedingsgewoonten (WeVo), RIVM, Bilthoven, The Netherlands, 2013.
- Symposium Physical Activity in Children, Maastricht University, Maastricht, The Netherlands, 2013.
- European Public Health Conference (EUPHA: oral presentation), Brussel, Belgium, 2013.
- Congres Jong geleerd, oud gedaan, FrieslandCampina, Wageningen, The Netherlands, 2014.
- OnderzoeksBeraad, Veldwerk Nederland (oral presentation), Almere, The Netherlands, 2015.
- 39th Annual Meeting of the British Feeding & Drinking Group (BFDG: poster presentation), Wageningen, The Netherlands, 2015.
- 14th Meeting of the International Society of Behavioral Nutrition and Physical Activity (ISBNPA: oral presentation), Edinburgh, Scotland, 2015.

Courses

- Introduction to structural equation modeling using Mplus, Utrecht University, Utrecht, The Netherlands, 2012.
- Introduction to multilevel analysis, Utrecht University, Utrecht, The Netherlands, 2012.
- Masterclass AGORA 'How to develop effective interventions in public health practice?', Graduate School VLAG, Wageningen, The Netherlands, 2012.
- Masterclass AGORA 'How to evaluate interventions in public health practice?', Graduate School VLAG, Wageningen, The Netherlands, 2013.

General courses and workshops

- Scientific Writing, Wageningen Graduate Schools, Wageningen, The Netherlands, 2013.
- Information Literacy including EndNote Introduction, Wageningen Graduate Schools, Wageningen, The Netherlands, 2014.
- Teaching and supervising Thesis students, Educational Staff Development, Wageningen University, Wageningen, The Netherlands, 2015.
- Philosophy and Ethics of Food Science and Technology, Graduate School VLAG, Wageningen, The Netherlands, 2015.
- PhD Workshop Carousel, Wageningen Graduate Schools, Wageningen, The Netherlands, 2015.
- Communication with the Media and the General Public, Wageningen Graduate Schools, Wageningen, The Netherlands, 2015.

Optional courses and activities

- Preparing research proposal VLAG, Wageningen, The Netherlands, 2013.
- Partner meeting SAPERE, Copenhagen, Denmark, 2011.
- Partner meetings Smaaklessen, Steunpunt Smaaklessen & EU-Schoolfruit, Wageningen, The Netherlands, 2011-2013.
- Partner meetings Voedsel Educatie Platform, Steunpunt Smaaklessen & EU-Schoolfruit, Wageningen, The Netherlands, 2014-2015.
- Staff seminars and research presentations, Division of Human Nutrition, Wageningen, The Netherlands, 2012-2015.
- Rothman lunches, Division of Human Nutrition, Wageningen, The Netherlands, 2014-2015.

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