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Beyond Healthy Eating: The Broader Impact of the Food Boost Challenge's Participatory Approach with Young People

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Abstract: The Food Boost Challenge (FBC) uses a community-up participatory action research approach to promote healthier eating habits among young people, aged 10–24 years old, by giving them a voice in food system change. This approach encourages turning ideas into action through collaboration with young people, both adolescents and students, teachers, researchers, and food system partners. This study explored the impact of the FBC beyond its direct effect on healthy eating behavior, focusing on innovative idea generation and how participation affected young people and partners, at both the individual and community level, using indicators of community-based participatory action research. Ideas generated in various phases of the FBC were listed. Data were collected using semi-structured interviews with young people, digital feedback surveys after group meetings, and informal discussions with partner representatives to explore the impact of participation in the FBC. The results demonstrate positive effects, including changes in participant's attitudes toward healthy eating, skill development among young people, and enhanced collaboration among stakeholders. Along the lines of the Community-Based Participatory Research conceptual model, the Food Boost Challenge fostered trust development, mutual learning, and capacity building at both individual and community levels. In conclusion, utilizing a community-up participatory action research approach, the Food Boost Challenge shows significant promise in empowering young people and fostering community-level changes. To translate its generated innovative solutions into real impact, a structured implementation phase is essential.

Keywords: participatory action research; young people's health; community building; social impact; food system; healthy eating; youth engagement; community-based participatory research outcome model; collaborative framework; community-up

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1. Introduction

The global burden of overweight and obesity, coupled with the increasing prevalence of non-communicable diseases like cardiovascular disease, cancer, and diabetes, underscores the critical need of prevention (Global Burden of Disease 2019 Risk Factors Collaborators 2020). Prevention benefits from a life course approach, in which adolescence,

between the ages of 10 and 19 years old, serves as a pivotal stage for intervention. This developmental stage marks the transition from childhood to adulthood, during which young people's bodies and minds are prepared for adult life and, if healthy habits are prolonged or initiated, it has the potential to support a healthy next generation, i.e., their future children. Therefore, adolescence is not only a time of rapid physical growth but also a period when healthy dietary habits and food environments and sufficient physical activity can significantly shape long-term health outcomes. However, it is crucial to recognize that adolescence is a complex life stage during which significant physical, hormonal, and emotional shifts, coupled with identity exploration and increasing social influences, make it challenging for young people to navigate their relationships with food, as food choices become intertwined with social norms, identity formation, and the expression of belonging. These factors can lead to complex and sometimes unhealthy food-related behaviors, resulting in an increased risk of overweight or obesity or of eating disorders. Even for healthy adolescents, their relationship with food changes as a result of their increased independence during this time (Ziegler et al. 2021). They will be making more food choices on their own, often influenced by peer groups and social media. Our approach, the Food Boost Challenges, maximally accommodates for this complexity of adolescents (van Lieshout et al. 2023a). During adolescence, peer feedback is far more effective than adult feedback in influencing behavior (Crone and Dahl 2012), as adolescents are particularly sensitive to social dynamics and peer validation during this developmental stage. Engaging adolescents as active participants in reshaping their food environment and fostering healthier behaviors capitalizes on their need for autonomy and their receptiveness to peer-led collaboration (Schut 2022; Patton et al. 2022). Such engagement not only supports their personal development but also enables food system partners to benefit from adolescents' unique creative potential, as they are highly capable of generating divergent and innovative solutions during creative processes (Crone and Dahl 2012). This collaboration and creative process, at least in children, actually also benefits from expert feedback (Schut 2022).

Participatory action research (PAR) offers a promising approach to engage young people, aged 10–24 years old (van der Vlegel-Brouwer et al. 2023). However, in addition to the logistic challenges of reaching young people, engaging them as co-researchers or co-designers in participatory action research presents unique challenges, including navigating their evolving motivations, maintaining sustained interest, and harnessing their creativity in meaningful ways (Warraitch et al. 2024). Addressing these challenges requires fostering emotional engagement and a sense of ownership, which in turn significantly affects their involvement and the success of their creative ideas.

Transforming the food environment cannot be achieved by a single party, such as either consumers, retailers, or the food industry, but requires active involvement of all partners in the food system (Wopereis et al. 2024). An example of reshaping the food environment with all partners are living labs. Living labs have their origin in user-centered, real-life innovations in ICT, but they are increasingly being explored and studied as means to address societal problems and develop viable solutions for a variety of problems (Chapagain and Mikkelsen 2023; Ballon and Schuurman 2015). Living labs serve as platforms for the cocreation, application, and evaluation of innovation services or products in a real-life environment, involving multiple stakeholders (Fotis et al. 2023; Haukipuro et al. 2019). In school-based living labs, for example, young people can act as both solution providers and active learners, engaging with local actors to co-develop and experiment with food-related innovations that reflect real needs and contexts (Chapagain and Mikkelsen 2023).

The food environment refers to the physical, economic, political, and socio-cultural surroundings, opportunities, and conditions that create everyday prompts, shaping peo-

ple's dietary preferences and choices as well as nutritional status (Swinburn et al. 2014). The food environment is the interface between the broader food system and individual food choices. Given the complexities of reshaping food environments, approaches like PAR and living labs, which prioritize active, real-world participation, have gained traction as innovative ways to involve young people directly in the process (Te Brinke 2021). This emphasis on stakeholder involvement and real-life implementation is consistent with the characteristics of living labs, which are that they have high participation rates and accelerate implementation (Fotis et al. 2023; Haukipuro et al. 2019). In order to enable positive change in the food environment of young people, it is of utmost importance that as many stakeholders as possible—from the entire food system around these youngsters—be involved, not only because more stakeholders can achieve more, but also because having a large number of stakeholders sends a strong signal of importance and urgency, helping to set agendas both internally and externally. This ensures that the wishes, needs, and interests of all parties are included, while also enabling ideas to be immediately tested, tried out, and potentially scaled.

In an attempt to promote healthier eating habits among young people, four organizations—namely, Horti Heroes, Foodvalley NL, The Hague University of Applied Sciences, and the Medical Delta Living Lab VIT for Life—jointly initiated and developed the Food Boost Challenge (FBC), a collaborative initiative combining education, research, and real-life innovation (van Lieshout et al. 2023a). After a successful first edition, the FBC was continued and further developed in subsequent years. The FBC aims to give young people a voice in food system change and turn ideas into action through collaboration with young people, both adolescents and students (aged 16–24 years old), teachers, researchers, and food system partners. The FBC is an innovation process with four phases, involving young people both in their role as peer researchers and in their role as the target group, teachers, researchers, and food system partners throughout the quadruple helix, ranging from governmental organizations and NGOs to start-ups, scale-ups, and multinationals. Phase 1—situational problem analysis—involves peer research identifying the barriers to and drivers of healthy eating behavior among young people, aged 10–24 years. In phase 2—idea generation—teams of students of pre-vocational education, vocational educational institutes, and universities submit innovative ideas, resulting in concepts fitting into one of four routes: (I) innovative technology for a healthy diet, (II) new food products/concepts for young people, (III) hotspots improving the healthy eating experience, and (IV) new routes to the market. In phase 3—cocreation and prototyping—teams of adolescents, students, and partners are formed to develop selected concepts into prototypes, and phase 4—finals and prototype experiencing—offers teams a national platform and enables a jury and a lay audience to experience the prototypes through pitches, videos, tastings, visuals, maquettes, etc.

To date, two 9-month FBCs have taken place in the Netherlands (Food Boost Challenge 2021b). In brief, the two editions of the FBC resulted in generating almost 20 prototypes aimed at promoting healthier eating habits in the broadest sense, that is, across four solution directions: new food products, technologies, routes to the market, and physical or digital hotspots for healthy food experiences (van Lieshout et al. 2023a). As described in van Lieshout et al. (2023a), assessing the effects of the FBCs on healthier eating habits is not straightforward. This is partly due to the long-term and gradual nature of behavior change and also due to the complexity of adolescence as a developmental stage during which young people face emotional, social, and identity-related challenges that influence their relationship with food and their ability to make conscious, health-promoting choices. It has also not yet been studied whether the FBC reaches its goal of giving young people a voice in food system change, nor has it been assessed to what extent the Food Boost Challenge

affects those involved, both at the individual and at the community level. Such effects are likely to exist, as also described by Oetzel and colleagues (Oetzel et al. 2022) in their paper on the broader social and systemic effects of Community-Based Participatory Research (CBPR) using the CBPR outcome model. The FBC aligns closely with the Community-Based Participatory Research conceptual model by Belone et al. (2016). As indicators of impact, they identified trust development, capacity, mutual learning, and power dynamics among its diverse multi-stakeholders. While PAR has shown promise in engaging youth in health-related behavior change (Frutuoso et al. 2022), the nature of this impact beyond health, i.e., impact at the individual and community level, has not been extensively studied (Patton et al. 2016). In addition, the role of multi-stakeholder collaboration in food system interventions is underexplored, with few studies examining how young people, alongside businesses, schools, NGOs, and other food system actors can drive broader social transformation (Oetzel et al. 2022; World Health Organization 2017; Oni et al. 2020).

Research on the long-term sustainability and implementation of adolescent-driven food innovations remains scarce (Utter et al. 2011), leaving a gap in understanding how promising prototypes can be scaled up and sustained in real-world settings. In order to increase our understanding of these existing gaps, we explore the impact of the FBC by focusing on innovative idea generation and how participation affected young people and partners, at both the individual and community level, using the following indicators of community-based participatory action research: trust development, capacity, mutual learning, and power dynamics.

2. Setting and Methods

2.1. Setting

To date, two 9-month FBCs have taken place (Food Boost Challenge 2021b). Both FBCs followed the participatory action research design, as described in full detail for FBC-2022 (van Lieshout et al. 2023a).

Table S1 provides an overview of the main similarities and differences between both FBCs in relation to various aspects. In brief, FBC-2022 ran from August 2021 until May 2022 in the region "Westland", in the west of the Netherlands, a region famous for its innovative glasshouse horticulture, producing vast amounts of vegetables and fruits, set among a mix of villages and small towns. This FBC aimed at enhancing the consumption of vegetables and fruit (V&F) products by young people; 38 partners provided both cash and in-kind contributions to join the FBC community (Food Boost Challenge 2021a). In Phase 1, 200 peer research students at The Hague University of Applied Sciences, from 8 educational departments, identified the barriers to and drivers of the consumption of V&F products among 1000 pre-vocational young people, aged 12–20 years (van Lieshout et al. 2023a). In phase 2, 25 student teams from universities submitted innovative concept ideas. In phase 3, 10 student teams—from 11 universities—were selected to form consortia of young people and partners for the cocreation and validation of their prototypes. In the finals, 4 student teams won a variety of prizes (Food Boost Challenge 2021b). FBC-2023 ran from August 2022 until May 2023 in the south of Limburg, an industrial region in the south-east of the Netherlands with poorer health statistics compared to the rest of the country. This FBC aimed at making the healthy choice the easy choice at hotspots such as football stadiums and festivals and everyday hotspots such as school and/or sports canteens, where many young people gather. In this FBC, 27 partners (of which 3 also participated in FBC-2022) provided both cash and in-kind contributions (Food Boost Challenge 2021a). In Phase 1, in 2 intra-curricular modules of Hotel Management School Maastricht at Zuyd Hogeschool, more than 60 peer research students identified the barriers to and drivers of making the healthy choice the easy choice in almost 500 young people,

aged 12–20 years, in Limburg, the Netherlands (van Lieshout et al. 2023b). In phase 2, 20 student teams of pre-vocational schools, vocational schools, and universities throughout the south of the Netherlands submitted innovative concept ideas. In phase 3, 9 student teams—from 10 schools and universities—were selected to form consortia with adolescents and partners for the cocreation and validation of their prototypes. In the finals, 4 student teams won prizes (Food Boost Challenge 2021b).

Partners were initially recruited through the direct network of the Food Boost Challenge founders. Once a sufficient number of partners had confirmed their involvement, they were mapped onto the food system landscape to assess its representation across a variety of sectors. This mapping also included identifying whether partners were present for each of the four solution directions. To address any gaps or blind spots, an additional round of recruitment was conducted, reaching both within and beyond existing networks. Industry partners of the FBC represent three sectors, namely the Food and Beverage Industry, the Agricultural and Horticultural Sector, and Technology and Innovation Firms, each contributing unique expertise to the challenge. Table S2 provides an overview of the innovative and/or creative techniques that students applied in their peer research and the number of young people they studied in phase 1 of each FBC. In Table 1, this peer research is summarized with respect to key aspects.

Table 1. Aspects of peer research during phase 1, situational problem analysis, and a summary of how they appeared in the student research projects in both Food Boost Challenges (FBCs) (van Lieshout et al. 2023a; van Lieshout et al. 2023b). See Table S2 for a complete overview of all peer research projects.

Aspect of Peer Research	Summary of Their Appearance in both FBCs
Research and design questions	• A wide range of topics related to young people's eating behaviors, including perceived barriers and motivators for healthy eating, food preferences, communication strategies, and environmental influences. • Many projects were exploratory in nature, while others focused on testing or co-developing specific concepts, interventions, or communication tools.
Innovative and creative approaches	Students applied diverse and creative methods, including behavioral research, concept and prototype development, app design, cross-media campaigns, and school-based interventions tailored to their peers.
Research output	Outputs included posters, videos, reports, prototypes, cross-media campaigns, intervention concepts, and contribution to the FBC manual.
Peers being studied:	
• Target group	• Young people, 12–26 years old.
• School types of target group	• Pre-vocational, vocational, and international schools.
• Locations of schools	• Studies conducted across multiple Dutch cities and school types (e.g., Gouda, Poeldijk, The Hague, Heerlen, Sittard, etc.).
Students conducting peer research:	
• School type of students	• Students from universities of applied sciences and vocational education programs.
• Year of study	• Across multiple years of study, from year 1 to graduation.
• Institutions involved	• Research projects carried out at The Hague University of Applied Sciences *, Zuyd University of Applied Sciences, HAS Green Academy, and Graphic Lyceum Rotterdam *.
• Disciplines represented	• Nutrition and Dietetics, ICT, Communication, Business, Hotel Management, Food Innovation, Graphic Design, etc.

* All projects during FBC-2022 at these institutions took place in the academic year 2021–2022, before, during, and after the COVID-19 lockdown of schools and universities.

In this paper, we explain how the FBC approach serves as an example of an overarching community-up PAR. Within this approach, phase 1 of the FBC can be considered a PAR iteration itself, as it focuses specifically on engaging young people in a participatory research process to identify key barriers and drivers for improving health-related behavior. The overarching PAR methodology of the FBC involves multiple stakeholders—adolescents, students, researchers, and partners from the quadruple helix in the food system —collaborating throughout the project's four phases. The goal is to cocreate solutions that promote healthier eating habits among young people. Within this broader process, phase 1 applies these PAR principles at a more local level—mostly in school settings—specifically engaging young people through peer-led qualitative research methods. All students conducting peer research were instructed to use innovative and/or creative approaches aiming for optimal engagement of their peers. Therefore, students developed and applied activities such as focus groups, interviews, and interactive classroom activities such as "cross the line", the "sticky notes game", a "would you rather—choice game", and an "association game", as well as classroom quizzes using digital tools. These digital tools were interactive versions of questionnaires, such as the Kahoot quiz and Socrative. Interactive activities were used for assessing preferences, current behavior patterns, and underlying determinants. These approaches allow for the deep engagement of young people throughout the FBC, ensuring that both the overarching approach and the different phases are cocreated with the community. The PAR in phase 1 plays a critical role in understanding the needs, motivations, and preferences of young people (van Lieshout et al. 2023a), which subsequently inform the design and development of solutions in later phases of the FBC.

2.2. Methods

The impact of the Food Boost Challenge (FBC) was evaluated using a mixed-methods approach, including semi-structured interviews, digital surveys, and informal partner management conducted across different phases of the FBC. This approach aimed to broadly assess the impact of the FBC on participants and partners, at an individual and community level. The questions were developed along the indicators of the CBPR conceptual model by Belone et al. (2016): trust development, capacity, mutual learning, and power dynamics. However, the questions had a more exploratory character in order to both evaluate the process and capture the multiple facets of participants' experiences, such as skill development, interactions with peers and partners, and changes in attitudes towards food. See Section 2.3 for a description of the ethics protocols which were respected throughout the research process and see Section 4, Discussion, for a reflection on further strengthening the ethical framework of the FBC.

2.2.1. Individual-Level Measurements

- Semi-Structured Interviews: To explore the individual and community-level impact of the FBC PAR approach, we conducted semi-structured interviews with participants involved in the FBC.
    - Phase 1 student projects in FBC-2022: Nine groups, working in intra-curricular projects on assignments of which the FBC served as external commissioner, were invited in person and via email to have 1 member interviewed. Since the interviews were extra-curricular and mostly after the completion of their educational project, participation was voluntary, without compensation, and groups could decide who would represent them.
    - Phase 1 student projects in FBC-2023: All four students were invited in person and via email or phone to have an interview. The interviews were extra-

curricular and performed quite long after the completion of the educational project; participation was voluntary and without compensation.

- Phases 2–4, PAR, in FBC-2023: All eight groups that had reached phase 4 were invited repeatedly in person and via email to have 1 member interviewed. Participation in the FBC and these interviews was extra-curricular and voluntary for these students. No compensation was provided and groups could decide who would represent them.

These interviews were used to understand how the participatory process had influenced the student participants' perceptions of their role, emotional engagement, and sense of agency. FBC-2022 interviews were conducted by a 3rd-year Nutrition and Dietetics student. FBC-2023 interviews were conducted by a 4th-year Hotel Management School student and the FBC-2023 project manager (M. H. I. v. R.). The interviewers were not pre-trained for these interviews but had all previously been trained in qualitative research methodology throughout their formal education. All interviews took place towards or after the completion of the group activities in which the students had participated. Interviews were conducted online using Teams or Google Meet, and audio recordings were made after verbal approval by participants. A semi-structured interview guide was developed by the principal researcher of the FBC (M. v. L.), and minor adjustments could be made after each interview by the interviewers in order to ameliorate the flow of the interview. This resulted in an interview guide with 13 questions that required a broader, more thoughtful response and 6 follow-up questions. The recordings were transcribed verbatim after which the recordings were deleted. The transcripts were subsequently anonymized. In the transcripts, the interviewers and researchers, based on subjective judgment, highlighted relevant passages indicating impact of the respondents' participation in the FBC along the lines of the CBPR conceptual model by Belone et al. (2016).

2.2.2. Community-Level Measurements

- Digital Feedback Surveys (Phase 3–4): To assess aspects of community building and in order to improve the process of the FBC, we collected anonymous qualitative feedback using digital feedback surveys after the cocreation session and after the finals in FBC-2022. This feedback primarily helped improve event quality, participant engagement, and captured the perspectives of stakeholders—including adolescents, businesses, NGOs, and educational institutions—providing practical insights into how to strengthen collaborative efforts.
- Informal Partner Management (Phase 1–4): To register points of improvement, we held informal partner meetings during FBC-2023. This process captured the experiences and lessons learned from various partners involved in the FBC, supporting our exploration of the food system and how promising prototypes could be scaled up and implemented. Information was gathered by conversations of the project manager with partner representatives throughout FBC-2023 and after the final event of FBC-2023. The most important learnings were documented in meeting minutes, written by the project manager and agreed upon by the project team, including the researchers enabling them to discuss and summarize the perceived and expressed impact and further improve the FBC approach. For the purposes of this paper, only anonymized findings are shared.

By linking these methodologies to the specific research gaps, this study sought to understand how FBC's PAR approach impacts those involved at the individual and community levels.

2.3. Ethics

All research activities described above followed the guidelines for applied research as prescribed for Dutch universities (Kenniscentrum Zorginnovatie 2019). To ensure the ethical implementation of the Food Boost Challenge (FBC), the following aspects were addressed:

- The participatory action research (PAR) in phase 1 relied in part on information collected by bachelor's degree students as part of their coursework. These students did not sign informed consent forms themselves nor collect consent from their peers during their projects. In phase 2, participants registered their ideas via a Google form, where they agreed to data storage. Participants subsequently selected for phases 3 and 4 signed an informed consent form guided by UNICEF's principles for working with young people.
- Participants under 18 years of age in phases 3 and 4 required an additional parental consent. This process aligned with UNICEF's guiding principles to protect minors.
- To minimize power imbalances, partners were explicitly briefed about both working and communicating with young people according to UNICEF's guiding principles. These principles emphasize respect, inclusion, and the empowerment of participants.
- Participants were informed that they retained ownership of their concepts until otherwise agreed. Teams were advised to exclude sensitive or technical details from their submissions and pitches to protect intellectual property. In phase 4, video pitches were made publicly available online, and participants were made aware of the potential for professionals to view and engage with their ideas. Partners were also briefed on this arrangement and agreed to respect the teams' ownership.
- At events where photos and/or videos were taken, all attendees were given the opportunity to identify themselves as not willing to appear in photos or videos. This ensured respect for individual preferences and privacy in accordance with ethical guidelines.
- No formal ethical approval was sought for this study, as it does not fall under the Medical Research Involving Human Subjects Act under Dutch regulations. Nonetheless, UNICEF's principles and the research guidelines for applied studies were followed to ensure ethical conduct.

3. Results

3.1. Results at the Individual Level

In Table 2, the number of participants invited and those who participated are listed for each method. Where possible, response rates are provided. For methods where response rates could not be precisely calculated we hypothesize that participation was influenced by factors such as timing of invitations, workload of participants, and the perceived relevance of the activity. This contextual overview helps interpret the scope and representativeness of the qualitative data described below. For the semi-structured interviews, 21 invitations were sent and eight interviews were held. The digital feedback survey was completed by 11 people, of whom 8 were partners, 2 were students, and 1 gave an anonymous response. This latter response could, most likely, be assigned to a partner based on the content, but this is speculative. The CBPR conceptual model by Belone et al. (2016) was used to exploratively develop the interview and survey questions. However, based on the interview transcripts, quotes are grouped into the following, more detailed and descriptive, themes: motivation for participation in phase 1 of the FBC, experience of participatory approach, influence on emotional investment, sense of agency, changes in own attitudes and behaviors, and perceived impact of research. Interviews lasted 20–40 min.

Table 2. Number of participants invited and participating for each, method exploring the impact of the Food Boost Challenge (FBC).

Method, Phase of FBC Under Review, and FBC Edition	Invited	Participating	Speculation About Non-Response
Measurements at individual level			
Semi-Structured Interviews about Phase 1, student projects, in FBC-2022 [1]	9 teams	5 students representing their teams	• Poor group cohesion; • Assignment with minimal involvement with FBC; • Education ended long before recruitment for interviews;
Semi-Structured Interviews about Phase 1, student projects, in FBC-2023	4 teams	2 students of the same team	• Assignment with minimal involvement with FBC;
Semi-Structured Interviews about Phases 3–4, FBC-finalist participants, in FBC-2023	8 teams	2 students representing their teams	• Three teams only entering FBC in phase 4 might have limited involvement with FBC; • Extra-curricular nature of FBC increased workload and limited availability of some teams; • Timing of interviews in weeks with many school and public holidays and exams.
Measurements at community level			
Digital Feedback Surveys, Phases 3–4, in FBC-2022	All people attending events	11 people, student participants and partners	• Potential overall questionnaire fatigue.
Informal Partner Management, in FBC-2023	All partners	No exact data available	

[1] All student projects in Phase 1 of FBC-2022 took place in the academic year 2021–2022, before, during, and after the COVID-19 lockdown of schools and universities.

Table 3 summarizes the main themes that emerged from the interviews with students structured along the CBPR model. It captures a range of insights across six key areas including motivation, collaboration, emotional investment, agency, behavioral change, and perceived societal impact. For each theme, relevant quotes are provided. The quotes illustrate how student participants experienced the FBC as a transformative and empowering learning process.

When assessing the qualitative answers of the digital surveys (phase 3–4), student participants highlighted the unique opportunity to interact with experienced professionals, which was perceived as inspiring and valuable for their development. They appreciated the inclusive nature of the event, in which participants from different age groups could contribute. Students also felt that their involvement in the FBC helped them step out of their comfort zone, particularly in tasks like pitching and collaborating in teams:

- Cocreation quote from a student: "It was incredibly cool to brainstorm with experienced professionals from large companies".
- Final quote from a student: "FBC promoted my development because I went out of my comfort zone".
- Final quote from a student: "I think it's a very flexible project, and appreciate that people from all different age groups can participate".

Overall, results on the individual level were positive, with an active involvement on the personal level and with several students who were involved in later stages of the FBC and spin-off activities over time.

3.2. Results at the Community Level

As stated in Table 2, the digital feedback surveys (phase 3–4) were completed by 11 people, of whom 8, probably 9, were partners. These partners are representatives of all organizations participating in FBC-2022, such as teachers, researchers, and food system partners throughout the quadruple helix, ranging from governmental organizations and NGOs to start-ups, scale-ups, and multinationals. Partners found the interactions with young people, representatives of the target group and students, inspiring, and they appreciated the enthusiasm students demonstrated throughout the process of the FBC. They also recognized the value of having other partners present and felt that all interactions contributed to community building. However, they did express concerns regarding the alignment of some outcomes with the intended goals. For example, the winning projects did not necessarily meet the Dutch dietary guidelines. Additionally, they suggested changes to improve inclusivity in awards to stimulate future talent:

- Cocreation quote from a partner: "I found it very inspiring and energizing! It was great to see the students working so enthusiastically and seriously on developing their ideas".
- Cocreation quote from a partner: "Multi-disciplinary teams, so that students can critically question each other".
- Final quote from a partner: "It is unfortunate that a product which does not meet the Dutch dietary guidelines won the biggest prizes".
- Final quote from a partner: "To stimulate and encourage future talent, it might be better not to let one team take home two prizes in the future".

Table 3. Main themes, type of indicator and level of impact, insights, and supporting quotes from interviews with 8 participants in phase 1 of the Food Boost Challenge. Type of indicator of impact assigned according to the Community-Based Participatory Research conceptual model (Belone et al. 2016). Level of impact at individual and/or community level. Most students were in the 3rd or 4th year of their bachelor's degree program. In general, they were between 19 and 22 years old.

Main Theme— Q: Example of Interview Question	Type of Indicator and Level of Impact	General Insights	Supporting Quotes
Motivation for participation in phase 1 of the FBC Q: What is the reason you chose this project? Why did you, of all projects, decide on the Food Boost Challenge?	Trust development and capacity; individual and community	Participants were motivated by personal interest and their educational requirements. Many appreciated the opportunity to contribute to the FBC's broader social development goal, i.e., a healthy next generation, and found the research aligned well with their areas of study, particularly those in Food Technology and Nutrition and Dietetics.	FBC-2022, augmented reality nutrition group representative [1]: "I think it's working with people from the other module. Because then you will get different and new insights. And working on an app is new to me and seemed like fun. And because it was quite free, still a blank sheet, you could really give your own interpretation to it". FBC-2023, graduation project student 1: "I was happy with it [the FBC, red.], because it is a good initiative. Positive".
Experience of participatory approach (between: students and young people; students and students; students and partners) Q: How did you find the interaction with the target group and partners during the FBC process?	Mutual learning, trust development, and power dynamics; individual and community	Participants appreciated working cross-disciplinarily with other students and/or partners [2], allowing them to focus on their areas of expertise and learn from others. However, challenges in communication and the initial lack of clarity about project goals were noted. The open and flexible nature of the project was seen as beneficial but also at times perceived as too challenging.	FBC-2022, augmented reality ICT group representative: "The collaboration with a group of nutrition & dietetics students was very enjoyable for us, because we could focus on what was important for us". FBC-2023, graduation project student 1: "We were doing something, but we did not know what specific end goal we were working towards".
Influence on emotional investment Q: What moment during the project stood out for you, and why?	Trust development, power dynamics and capacity; individual	Emotional engagement was observed, with participants feeling connected due to their involvement in a real-world project that allowed for creative input. Participants reported that the hands-on, applied nature of the research kept them motivated, even when facing setbacks.	FBC-2022, augmented reality ICT group representative: "I personally really liked it. The whole concept of the app was a lot of fun for me. It was more motivating to work on it". FBC-2023, graduation project student 2:" I have also learned to deal with setbacks. Certain major things went wrong with a project like this. Numerous students would become quite angry. But in the end we also learned to persevere and make something great out of it".

Table 3. *Cont.*

Main Theme— Q: Example of Interview Question	Type of Indicator and Level of Impact	General Insights	Supporting Quotes
Sense of agency Q: What responsibility did you take on during the FBC, and how did it shape your decision-making abilities?	Power dynamics and capacity; individual and community	Participants reported a sense of agency through their ability to take ownership, develop new skills, and influence project outcomes. Opportunities to assert themselves in decision-making and contribute to tangible outputs played a significant role in fostering this sense of agency.	FBC-2022 graduation project, student 2: "And then some things were accepted from us without 8 different actors making a fuss over it, and it was simply accepted and we could simply continue our actions. Progress in the project because our work was being taken into account". FBC-2023, business administration group representative [1]: "I learned to take responsibility for certain parts of the project and to make decisions that made a big difference".
Changes in own attitudes and behaviors Q: Did working on this project change how you approach food choices?	Capacity and mutual learning; individual	Some participants mentioned becoming more conscious of their dietary habits through the research. However, this change varied among individuals, and for some, their existing habits and knowledge remained largely unchanged.	FBC-2022, minor Food Product Design student: "I cook a couple times a week for my family. And I've started to make dishes that are much more heavy in vegetables". FBC-2023, minor Food Service student: And I'm just much more aware now. Concerned with nutrition and actually living healthy.
Perceived impact of research Q: How did participating in this project make you feel about contributing to real-world change, and how do you perceive its impact?	Capacity and mutual learning; individual and community	Participants highlighted their sense of achievement through contributing to a project aimed at increasing vegetable intake among young people. Tangible outcomes, such as app development, reinforced their sense of agency and contribution.	FBC-2022, Behavior, Lifestyle, and Tools–nutrition students [1]: I found it nice that we did not start with nothing. You can really further develop what is already there. That really gives the feeling that you can make an impact and not so much that you are working on a fictional project. FBC-2023, graduation project student 2: We spoke to someone who said "Yes, I never eat vegetables, I often eat french fries". They said they were more likely to grab a piece of fruit afterwards, so that had an impact anyway.

[1] These students are in the 2nd year of bachelor's degree studies. In general, they are between 18 and 20 years old. [2] Partners in phase 1 mainly include teachers and researchers.

Figure 1 visually summarizes the perceived and expressed impact of participation in the FBC across its four phases, based on combined insights from interviews, digital surveys, and partner management discussions. It illustrates how the FBC—at both the individual and community levels—has contributed to key indicators of impact beyond health behavior, including growth in capacity, trust, mutual learning, and shifts in power dynamics among both students and partners. Specifically, the figure shows how students developed a greater sense of agency, increased their confidence, and gained new skills through their participation, particularly in the later phases where their ideas gained visibility and validation. Their emotional engagement also increased over time, as cocreation and interaction with professionals strengthened their motivation and belief in their contributions. For partners, participation led to a broader understanding of youth perspectives and encouraged more collaborative, less hierarchical relationships—an indicator of changing power dynamics. Mutual learning occurred as students and partners exchanged knowledge and perspectives, suggesting that the FBC facilitated a genuine two-way process of learning. Capacity building took place at multiple levels: students gained transferable skills (e.g., teamwork, communication, entrepreneurship), while institutions developed new ways to embed youth engagement more meaningfully. Overall, Figure 1 offers a consolidated overview of these broader social and organizational impacts, aligned with the FBC's aim to go beyond individual behavior change and foster community-up transformation in the food system.

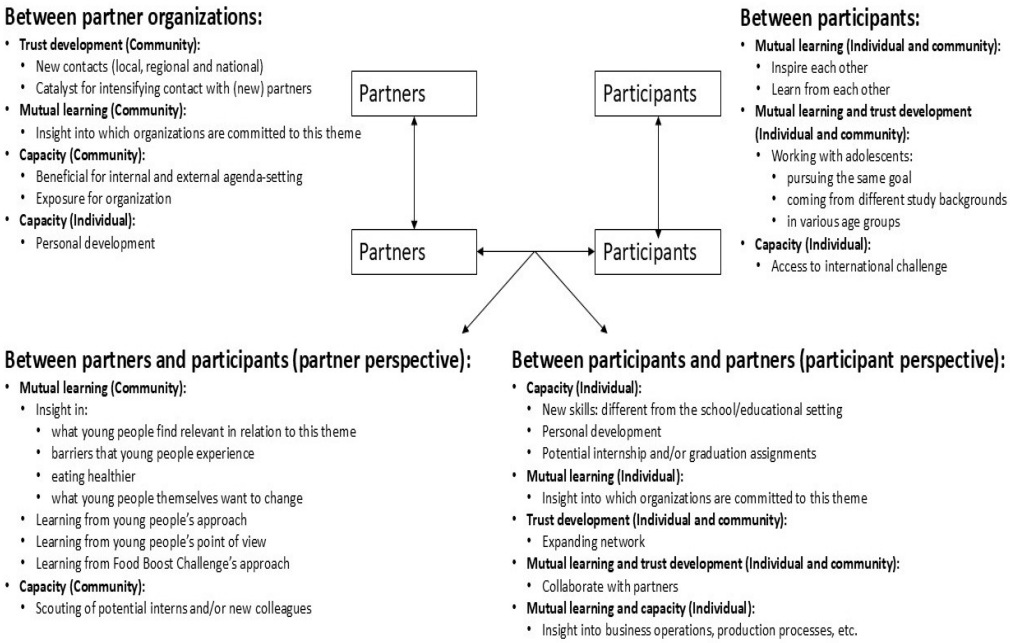

Figure 1. Overall perceived and expressed impact of the Food Boost Challenge (FBC) at the individual and community levels among student participants and partners distributed over indicators of impact extracted from the Community-Based Participatory Research conceptual model by Belone et al. (2016). Partners include teachers, researchers, and food system partners throughout the quadruple helix, ranging from governmental organizations and NGOs to start-ups, scale-ups, and multinationals. For the compilation of this summary, data from semi-structured interviews with students, digital feedback surveys, and informal partner management meetings of phases 1–4 of FBC-2022 and FBC-2023 were used.

4. Conclusions and Discussion

In this study, we set out to explore the impact of the Food Boost Challenge (FBC) by focusing on innovative idea generation and how participation affected young people and partners, at both the individual and community level, using the following indicators

of community-based participatory action research (CBPR): trust development, capacity, mutual learning, and power dynamics. These indicators are based on the CBPR conceptual model by Belone et al. (2016). The analysis of interviews, feedback surveys, and partner management meetings revealed impacts categorized under trust development, mutual learning, power dynamics, and capacity, both at the individual and at the community level.

Trust development emerged as a key outcome, influencing motivation and active engagement. At the individual level, participants felt motivated by the trust they had in the collaborative nature of the FBC. This trust facilitated their emotional investment and subsequent involvement and commitment to the project. This was further increased as they valued the opportunity to contribute to broader social goals. At the community level, new contacts among partner organizations and enhanced understanding of each other's commitments were crucial for building trust, which in turn strengthened partnerships and overall engagement.

Mutual learning played an important role, fostering growth at both individual and community levels. Participants enriched their understanding of the food system through learning from peers and partners, while partners gained insights into young people's perspectives and challenges in healthier eating. This reciprocal learning enhanced skills and networks for participants and contributed to community building, as participants inspired each other and worked towards shared goals. Mutual learning thus not only supported individual growth but also helped create a stronger community advocating for healthier eating habits.

Power dynamics influenced participants' sense of agency, particularly at the individual level. Participants expressed feeling empowered and being able to take ownership and make meaningful decisions. However, challenges such as unclear roles and communication difficulties highlighted how power imbalances could hinder effective participation. Addressing these barriers is crucial to ensuring that all participants feel equally valued and capable of contributing meaningfully.

Capacity building was evident at both individual and community levels. Participants gained practical skills beyond their formal education, leading to personal growth and behavioral changes. The latter became evident through their answers to questions such as "Did working on this project change how you approach food choices?", from which we identified an increased awareness of healthy living. Involvement in the FBC also allowed participants to explore internship opportunities and gain exposure to real-world business operations. At the community level, partners benefited from organizational capacity building, gaining valuable insights and opportunities for agenda setting. These outcomes demonstrated enhanced capacity not only for individual participants but also for partner organizations through shared learning and collaboration.

While these findings highlight the promising impact of the FBC on both individuals and communities, it is important to recognize certain limitations that may have influenced the results and interpretations. First, it should be noted that these qualitative analyses are based on relatively small numbers of participants. Mainly insights from student participants and partners participating in phases 3 and 4 are included. The voices of teachers and researchers participating as partners in phase 1 are under-represented. For example, in FBC-2022, although all nine student groups were invited to have one member interviewed, as a representative of their group, only representatives of five groups participated in the interviews. In FBC-2023, all four students in a graduation project group in phase 1 were invited, and two students participated. All eight student teams that reached phase 4 of FBC-2023 were invited to be interviewed. However, only the representatives of two student teams were interviewed. This resulted in nine interviews, but one student team did not participate in phase 1 of FBC-2023. Therefore, their qualitative insights were not taken

into account in the interview analysis but were included in the digital feedback survey analysis. Similarly, not all partners voiced their experiences to the same extent. After FBC-2022, partner management had a more structured character within the organization of the FBC. For future editions, it is recommended to further embed this in the communication pathways, not only to improve the experience for partners but also for student participants, as the results described in this paper suggest this would positively affect power dynamics in PAR.

Apart from the above methodological constraints, the analysis described in this paper is also limited by the fact that the FBC was not initially designed with the deliberate intention of applying a PAR approach. Therefore, it may not have been executed following the exact recommendations for a PAR or CBPR approach. It is, however, now widely recognized that the FBC is a mix between community-up participatory action research and design thinking. Therefore, it is recommended that all the building blocks of PAR, as identified by Cornish et al. (2023), be evaluated and valued for their suitability, necessity, and feasibility of integration into the FBC approach. In future FBCs, response rate for interviews might be increased by conducting them during, or shortly after the completion of, intra-curricular student projects and/or FBC events and by offering compensation for students' time. The PAR described in this paper is innovative in that it enables the participation of a large number of students through intra-curricular education, especially in phase 1 of the FBC. These students, in turn, reached a large number of young people, at times through the latter's educational activities. This PAR structure makes it possible to expand participation and ensure that multiple layers of the community are actively engaged. It is promising to see that student participants mention their emotional investment both in the goals and in the approach of the FBC. This is important because emotional investment is a marker of longer-term engagement which in turn is required for the successful implementation of community-up initiatives.

Of course, for such implementation trajectories not only student participants, but also partners should be engaged in the long term. At this point in time, the FBC has a number of recurring partners, which is a promising commitment. However, in future editions, more explicit briefings about the role and expectations of partners might be required. This could also diminish the effect of a common vulnerable aspect of PAR, as identified by Cornish et al. (2023), namely an unequal distribution of knowledge. This unequal distribution in knowledge may elicit "sending information" instead of stimulating dialogue (Seven Senses 2024). Although not specifically noticed in the analyses described in this paper, the FBC could, with an expert jury in phase 4, be vulnerable to this phenomenon.

This potential vulnerability is one of the examples highlighting the complexity of ensuring the ethical implementation of participatory action research (PAR) in a project as multifaceted as the FBC. While great care was taken to adhere to ethical guidelines, several aspects warrant reflection. A notable limitation was the lack of anonymity for participants and partners, as information about the FBC is publicly available online through pitches, press releases, and event media. While this transparency supports the promise of a national platform and generates publicity for the good cause—i.e., a healthy next generation—it raises challenges in terms of balancing transparency with privacy. Although attendees were given the opportunity to opt out of appearing in photos and videos, the public nature of the events and the online availability of information emphasize the need for a careful management of privacy concerns. Future iterations of the FBC should enhance these efforts to ensure participants feel informed and empowered to make decisions about their media presence. In addition, implementing ethical principles in a study of this scope required navigating numerous challenges, including ensuring informed consent across multiple phases, managing power dynamics, and maintaining fairness in ownership agreements.

These complexities underscore the need for ongoing efforts to refine ethical practices. While the informal discussions provided valuable insights, we acknowledge that this procedure might lead to incomplete capture of all ideas and themes. This limitation to some extent reflects the inherent challenges of qualitative research and the dynamic and iterative nature of participatory processes. Interestingly, the results did not indicate instances of negative power dynamics between participants and partners. This finding suggests that the emphasis on UNICEF's guiding principles and explicit briefings to partners were effective in fostering respectful and inclusive cocreation and collaboration. Finally, the current ownership agreements ensured that participants retained control over their ideas during the competition. However, as students progress in their studies and lives, revising these agreements to facilitate the further development and implementation of ideas becomes crucial in order to turn ideas into action. The existing guideline has therefore been reworded for FBC-2025. To further strengthen the ethical framework of the FBC, a law student will undertake an internship in 2025 to provide recommendations on ethical aspects of the FBC. This initiative aims to address gaps and further enhance the project's ethical rigor. By reflecting on these considerations, we aim to improve the ethical implementation of future iterations of the FBC and provide a robust foundation for scaling and sustaining participatory research initiatives.

An important consideration for future iterations of the FBC is the appropriate age range of participants. While the program aims to engage a diverse group of students, the age range must align with the program's structure and logistics. Many FBC events take place after school, often running into the evening and involving travel by public transport. These factors informed the decision to maintain the minimum age limit at 16, ensuring students have the maturity and independence needed to participate effectively. In the Netherlands, vocational students and those studying at applied universities typically undertake internships during most years of their studies. As such, the FBC's networking opportunities and skill-building experiences are highly relevant and beneficial for students at all levels, as well as for participating partners.

Fortunately, the vulnerability of unequal distribution of knowledge within community-up PAR can also be addressed through the very community-up approach itself. All parties should be briefed properly and supported accordingly in order to listen to and hear each party in order to jointly identify the exact solution which is both feasible and impactful. If this occurs, "more knowledgeable" partners benefit from the community-up PAR approach as it helps reveal discrepancies between perceived healthy solutions and objectively assessed healthy solutions. van der Vlegel-Brouwer et al. (2023) observed something similar but at the scale of a discrepancy between system-level solutions and real-world needs. Embracing PAR as an opportunity to shed a light on these mismatches is a blessing, as it can be key to fostering system-level change.

An example of such a mismatch became apparent during FBC-2022. The award-winning team, Veggie Smooth, proposed packages of frozen fruit (40%) and vegetables (60%) made from local residual products, designed to match young people's taste preferences. These packages could be prepared in a blender with water, offering a convenient solution. The prototype was tested among over 200 young people, who generally perceived smoothies as a healthy choice. However, a mismatch was revealed between perceived and objectively assessed healthiness: smoothies do not qualify as servings of fruits or vegetables under the Dutch dietary guidelines (Voedingscentrum 2024). Because community-up PAR approaches such as the FBC emphasize feasibility and impact, it is realistic to expect that solutions created by young people for young people might not fully comply with the strict Dutch dietary guidelines. Instead, these solutions should be viewed as a step in the right direction—an improvement from current behaviors. In the Dutch Food Consumption

Survey of 2012–2016, published in 2020, adolescents aged 12–17 years old consumed about 100 g of vegetables per day and about 110 g of fruit per day, which falls far short of the recommended intake of ≥250 g vegetables and ≥200 g fruit per day (Schuurman et al. 2020). In this context, a product like Veggie Smooth represents progress toward healthier habits. This view is supported by recent publications by Scheffers, which indicate that moderate consumption of pure fruit juice without added sugar or other ingredients by adolescents has fewer adverse effects than previously thought (Scheffers et al. 2022). Although smoothies are never a full substitute for whole fruits or vegetables, a product like Veggie Smooth could be a viable alternative for specific situations and target groups if consumed in moderation. Moreover, this product might have additional positive effects on health-related behaviors. In several phase 1 projects, young people expressed that they perceive smoothies as healthy, associating them with a healthy lifestyle. They reported that they therefore would like to consume them at hotspots such as sports canteens and fitness clubs, places where they nowadays often consume sugar-sweetened beverages and unhealthy snacks. Young people also self-reported making healthier choices throughout the day after consuming a smoothie, as it helped them avoid the "all is lost anyway" mindset, which they often experience after consuming fast food.

This paper contributes to addressing the existing research gap on multi-stakeholder collaboration in food system interventions by providing empirical evidence on how young people can drive broader social transformation, as identified by a number of authors and organizations (Oetzel et al. 2022; World Health Organization 2017; Oni et al. 2020). The findings of these FBCs highlight the potential of young people-driven initiatives to influence systemic change by leveraging partnerships and shared goals. Additionally, the paper emphasizes the importance of creating supportive environments where young people feel empowered and valued as active contributors to food system transformation, shedding light on the complex dynamics and benefits of multi-stakeholder engagement.

Another prerequisite for change, of both the food environment and eventually the food system, that we identified throughout the process is the need to assess readiness for change for the various partners in advance of their participation. This is a lesson also learnt in scaling-up the implementation of school-based physical activity interventions (McKay et al. 2024). Turning ideas into action through the implementation of solutions generated in the FBC was one of the two main aims of the FBC. These FBCs generated a number of promising solutions and a large number of spin-off projects. However, in future FBCs, a fifth phase for implementation is being included. For the design of this implementation phase, the lessons learned from Chandanabhumma et al. (2023) will be applied in order to enhance the sustainability of these implemented solutions and innovations.

The other aim of the FBC is to give young people a voice in reshaping the food system. In future editions, this should be studied in more detail, and not only in participants but also in young people participating either as peer researchers or as the target group in phase 1 or as beneficiaries of implemented ideas in phase 5. For example, through the use of the RE-AIM framework (Glasgow et al. 1999), it can be determined to what extent the FBC gives a voice to young people. The results obtained so far indicate that through the empowerment, sense of agency, and emotional investment of student participants, the FBC might be a powerful approach to give young people a voice. Through collaboration with a wide array of partners and impact at the community level, a start has been made with community building. These are essential steps towards long-term sustainability and implementation of young people-driven food innovations (Utter et al. 2011).

Although these analyses empirically show the FBC has an impact beyond health-related effects—an added benefit, as identified by Frutuoso et al. (2022) and Patton et al. (2016)—we recommend that this be studied in a more systematic manner during future FBCs. A tool

such as ripple effect mapping could be used for this purpose (Nobles et al. 2022). At a very small scale, student participants, and also some partners, indicated that they changed their health behavior as a result of participating in the FBC. Such changes, particularly among young people following the implementation of high-potential solutions, should be studied systematically, examining dietary intake, attitudes, and behaviors. Because ultimately, the FBC aims to promote healthier eating habits for a healthy next generation.

In conclusion, the Food Boost Challenge, utilizing a community-up participatory action research approach and evaluated utilizing the CBPR conceptual model, has shown significant promise in empowering young people and fostering community-level changes. To translate the innovative ideas generated into real impact, a structured implementation phase is essential. This will help ensure meaningful improvements in the food environment, food system, and health-related habits, marking an important step towards promoting healthier eating among young people—the next generation.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/socsci14040246/socsci14040246/s1, Table S1: Similarities and differences, with respect to various elements, between the Food Boost Challenges of 2022; Table S2: Innovative and/or creative techniques that students applied in their peer-research during phase 1 of both Food Boost Challenges (FBCs).

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Institutional Review Board Statement: The student research projects were conducted within the context of their intra-curricular school assignments. Therefore, in line with the Dutch "Kwaliteitshandboek Praktijkgericht Onderzoek", ethical review and approval were waived for this study.

Informed Consent Statement: Informed consent was obtained from all student teams and partners involved in the study.

Data Availability Statement: The data collected in the student research projects presented in this study are available on request from the corresponding author. The data are not publicly available due to the fact that they are made as part of their studies, i.e., a learning process. The student teams' ideas presented in this study are openly available and can be found here https://www.youtube.com/@FoodBoostChallenge/videos, accessed on 17 June 2023.

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