European Journal of Contemporary Education
E-ISSN 2305-6746
2024. 13(1): 67-81
DOI: 10.13187/ejced.2024.1.67
https://ejce.cherkasgu.press

Education for Sustainability in Czech Kindergarten: Example of Good Practice in Kindergarten Semínko – Growing Microgreens

Karolína Kapuciánová [a, *], Kateřina Jančaříková [a], Magdaléna Kapuciánová [a], Lucie Loukotová [a]

[a] Jan Evangelista Purkyně University in Ústí nad Labem, Ústí nad Labem, Czech Republic

Abstract

Education for sustainability is essential from an early age. The paper reports on evaluating a model early childhood education for sustainable development program called 'Growing Microgreens in nursery schools'. The program was developed in an environmentally specialized kindergarten, Semínko. Microgreens are young plants of various vegetable species grown in soil and harvested approximately after ten days. The simplicity of growing microgreens makes it an appropriate activity for preschool-age children. Besides rewarding the children with nutritious food, it brings children the opportunity to develop key competencies and pre-literacies. The program was developed in the Czech Republic in 2019 and is based on program theory. It was validated in 53 classrooms with 1051 preschoolers by the action research method (tools of mixed design). Activities were disseminated through a manual for teachers, which covered theory and practice, including legal and hygienic guidelines. Results were collected using a questionnaire. The evaluation focused on (a) quality and (b) efficiency. (a) Overall, using the predetermined criteria, involved teachers provided positive feedback on the program. Some complications were found, and possible solutions were suggested. (b) Most of the children (74 %) benefited from the program. The older (5-6 years old) benefited more than the younger ones. Better results were achieved in classrooms where the entire package of activities, including cultivation and theme-related activities, was implemented.

Keywords: early childhood education for sustainability, ECE settings, sustainable education, preschool, microgreens, education for a healthy lifestyle, gardening, LOHAS.

1. Introduction

Education for sustainability and a healthy lifestyle

We are in challenging times that require new and sustainable ways of living. The number of

* Corresponding author
E-mail addresses: karolina.kapucianova@ujep.cz (K. Kapuciánová)

people on our planet is growing exponentially. This forces us to change our behavior and live sustainably. Sustainable development is a scientifically grounded approach that aims to meet the needs of the present without compromising the ability of future generations to meet their own needs. It integrates environmental, economic, and social aspects, emphasizing resource conservation, equitable prosperity, and ecological balance (Brundtland, 1987). The United Nations declared 2005–2014 as the Decade of Education for Sustainable Development, emphasizing the role of education in achieving global sustainability (UN, 2015). Since the beginning of this decade, we have transitioned from environmental education to sustainability education. We are gradually shifting towards an era of environmental and sustainable education. We understand that the environment, sustainability, health, peace, and democracy are interconnected. Therefore, we need to establish strong relationships between children and their surroundings and between humans and non-humans (e.g., local food movements, whole school approaches, ecovillages). This is from the perspective of Wals et al. (2017).

In the context of sustainability education, LOHAS (Everage, 2002; Howard, 2007; Roberts, 2010) can be seen as a way to promote sustainable practices and a healthy lifestyle from an early age. By engaging children in gardening, healthy eating, and environmental responsibility activities, we can help them develop a sense of connection to our world and a commitment to preserving it for future generations.

Sustainability in kindergartens

This paper focuses on early childhood education for sustainability (ECEfS). Human actions profoundly impact the environment, which in turn affects young children. Group of preschool children was identified as one of the most essential and neglected groups (Davis, 2009), and it is still not receiving the attention it needs; however, much work has been started in this field (Davis, 2014; Davis, Elliot, 2014; Ärlemalm-Hagsér, Pramling Samuelsson, 2021).

Early childhood education (ECE) and education for sustainability share many similarities. Professionals in ECE adeptly utilize a range of techniques such as inquiry-based learning, contextualized learning, thematic teaching, storytelling, and leveraging children's everyday experiences to achieve this goal (Hägglund, Pramling Samuelsson, 2009; Daries et al., 2009; Engdahl, Ärlemalm-Hagsér, 2014). Kindergartens can promote sustainable learning communities by empowering children and adults to minimize environmental impacts and enhance sustainable practices in and beyond early childhood settings (Elliot, Davis, 2009; Daries et al., 2009). Despite these similarities and opportunities, early childhood educators are unfamiliar with the term ECEfS and do not know what sustainability means (Elliot, Davis, 2009). The barriers to discussing complex topics with children can stem from fear of complexity, concern about age-appropriateness, lack of research, or reluctance to make changes in their settings or no professional development in this area (Elliot, Davis, 2009; Daries et al., 2009; Davis, 2014; Ärlemalm-Hagsér, Sundberg, 2016; Engdahl et al., 2021; Furu, Heilala, 2021). Teachers often believe they are incorporating sustainability into their curriculum by simply being outdoors, informing about nature, and promoting recycling, while other aspects of sustainability are given less attention (Daries et al., 2009; Elliot, Davis, 2009; Davis, 2014; Ärlemalm-Hagsér, Sundberg, 2016; Engdahl et al., 2021). However, that is not enough. We must adopt a holistic approach highlighting the interconnections between social, economic, and environmental development and updating the curriculum and pedagogical theories beyond nature education (Davis, 2014; Davis, Elliott, 2014; Carr et al., 2021). We need a 'whole school approach' – to ECEfS, as Daries et al. claim (2009, p. 116):

The group recognizes that children follow our examples, not just what we say. Early Childhood Education settings and services need to be places where sustainability is practiced. This means that all early childhood education settings should examine their own 'ecological footprints' and work towards reducing waste in energy, water, and materials. They should aim to live out democratic and participatory social practices, and practice what they teach.

Several countries are taking steps towards Early Childhood Education for Sustainability (ECEfS), but Australia and Sweden are leading the way. This is evident in the professional uptake of Education for Sustainability (EfS), national curriculum initiatives, and research outputs (Davis, 2014; Ärlemalm-Hagsér et al., 2021; Engdahl et al., 2021). Finland is also highly concerned about ECEfS (Furu, Heila, 2021). Education for Sustainable Development has been integrated into the curriculum in several countries, such as the ones mentioned above. However, it has not yet been fully adopted in many other countries, including the Czech Republic. In contrast to these countries,

researchers are still struggling to emphasize the significance of nature for children. A holistic approach to sustainability is emerging very slowly.

Nonetheless, many individuals, initiatives, and facilities follow the example of more experienced countries and directly attempt sustainability in preschool education (Engdahl et al., 2021).

There is a global organization called Transnational Dialogues, comprising researchers who convene at conferences, exchange emails, hold online meetings, and collaborate to produce books. They primarily finance their travel and expenses for attending meetings, where they discuss the requirements of the ECEfS research and practice field (Davis, Elliott, 2014).

Czech kindergartens

The first public Czech preschool institution was founded by Jan Vlastimír Svoboda in 1832, and since then, preschools have shifted their focus from just caring for children to providing education (Opravilová, Uhlířová, 2017). Nurseries emerged due to the trend of working mothers, which continued during the socialist regime. However, this led to negative memories for many adults, and the number of nurseries decreased in the early 1990s when Zdeněk Matějček suggested mothers care for their children alone until age 3. The Czech Republic has over 5,400 kindergartens, serving over 94 % of preschool children. The country has public and non-public kindergartens. A public kindergarten class typically has one teacher for every 22 children (MŠMT, 2021).

The Czech curriculum is a framework (VÚP, 2021) that enables schools to use different forms and methods of education and to adapt instruction to specific regional and local conditions, opportunities, and needs based on the place and the community in which the children grow up. It has integrated character, focuses on critical competencies, and schools plan their work in integrated blocks. It propagates situation learning from everyday life situations in the context around the child. The curriculum is divided into five areas: the child and their body, the child and their psyche, the child and the other, the child and society, and the child and the world. Although sustainability is not explicitly included in the national curriculum for early childhood education, its principles are deeply ingrained. The Czech curriculum is undoubtedly a good starting point for sustainable education and has many opportunities for ECEfS.

In past years, many governments have provided financial support for every dimension of ESD (e.g., landscaping of the gardens and purchasing material for environmental education, multicultural education projects, and digitalization…). However, few initiatives in the Czech Republic are comprehensively oriented towards the whole ECEfS.

We discuss the implementation of ECEfS in the Czech Republic and review a program in Czech kindergarten Semínko, which was spread over the country, to provide insight into ESD interpretation and execution in ECE settings.

Semínko kindergarten

The kindergarten Semínko was founded by Emilia Strejčková, the nestor of Czech environmental education, in Prague, the capital of the Czech Republic (Strejčková, 2005; Jančaříková et al., 2024).

The Semínko Kindergarten was one of the first kindergartens in the Czech Republic to be established in an eco-centre. The kindergarten has garden and forest classes. Its curriculum includes many specific elements such as SWAPs, intergenerational meetings and celebrations, and diverse and inclusive feasts, and it emphasizes democracy as a crucial aspect of children's daily lives. Much attention is paid to nutrition (organic food). This kindergarten, therefore, serves as a demonstration kindergarten. Its gates are open to students in the kindergarten teacher education program. Semínko Kindergarten is a faculty school of Charles University, and teachers closely cooperate with academic researchers.

This paper introduces one of the activities that has spread from the Semínko Kindergarten to other Czech kindergartens: Growing microgreens with preschool children.

Growing microgreens with preschool children

Microgreens, also known as vegetable confetti, were first introduced in San Francisco, California, in the late 1980s (Kyriacou et al., 2016). These young and tender greens with many species have recently gained popularity as a culinary trend due to their unique characteristics. They are grown for 7-14 days and harvested above ground after developing fully developed cotyledon leaves (seed leaves). They are often used as decorative elements in meals due to their vibrant colors, textures, and flavors (Treadwell et al., 2020) and are an excellent source of vitamins (Xiao et al., 2012).

The program of growing microgreens with preschool children was designed in the kindergarten Semínko in 2019. The set of activities was designed by program theory (NAAEE, 2000; Rossi et al., 2004) and is based on legislative and curriculum documents (see Table 1). Sixteen sub-activities are divided into five stages of microgreens: activities with seeds (species recognition, creating mandalas, recognition of sounds), sowing (weighing, sowing, experience with geotropism), caring (watering, growth observation, poem with movement), harvesting and tasting (harvesting, tasting, production of flavored butter, creating a herbarium), and composting (vermicomposting, observation of compost loosening, microgreens for birds). In addition to cultivation, other activities are also included in which children use the topic of microgreens in individual stages of growth. The set is scheduled for 15 working days; every activity lasts 5 to 30 minutes daily. Implementing each activity is unnecessary due to insufficient tools, time, etc. However, it is required to cover all outputs (spider visualization is included; see Figure 1).

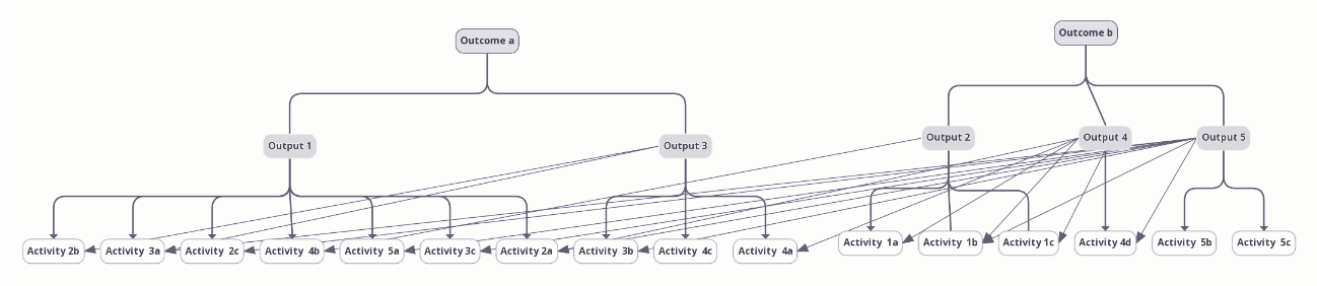

Fig. 1. Spider visualization

A magnetic board/cork bulletin board was used to record information (growing diary) during the program, filled with photos, tables, and drawings. This helped children compare the changes and communicate about the program with each other, parents, and teachers. It also helped with the final reflection.

Present study

This research aimed to determine if growing microgreens is appropriate for pre-schoolers and if it leads to specific outcomes. The study was conducted in the Czech Republic over five months, from November 2020 to March 2021. The activities were carried out in kindergartens during February and March (before school closures due to the Covid pandemic). A total of 55 female kindergarten teachers participated in the study, working in 53 classes with 1051 children. On average, there were 19.8 children per class. Nineteen teachers (with 483 children) finished the entire set.

2. Methods

The action research method was used. The action research was carried out using a set of activities summarised in a teacher's manual (Kapuciánová, 2021; Kapuciánová, 2021a). The manual's purpose was to make it easy for ECE settings to understand without additional explanation from the author while also educating teachers about the theoretical background. Moreover, it includes recommended aids, risk analysis, and legislative conditions for growing edible crops in kindergartens in the Czech Republic.

The action research aimed to improve an educators' practice by implementing changes involves action, evaluation, and reflection, all made by the participants, according to Clark et al. (2020). Both qualitative and quantitative approaches were employed. The teachers utilized observation, interview, and group discussion, considered qualitative methods. Meanwhile, the researchers used a qualitative and quantitative questionnaire (see Appendix 1).

The sample consisted of kindergartens who signed up to try a set of activities. It was promoted to schools through the initiative Truly Healthy School (*Skutečně zdravá škola*). We ensured that the enrolment represented the situation in the Czech Republic. Different types of kindergartens were included in the study, such as small and large kindergartens, urban and rural kindergartens, private and state kindergartens, kindergartens with a focus on environmental education, and those with a different focus, as well as kindergartens catering to children with special needs.

For environmental education, we focus on quality and efficiency in the evaluation (Jančaříková, 2010). Quality assessment (whether the activities are appropriate to the age and

number of children, suitably timed, ideally implemented, etc.) was evaluated according to the evaluation table using methods such as Czech education Centre '*Pavučina*' (Pavučina SSEV, 2022), which was modified for the needs of this study (see Appendix 1). Evaluating efficiency can be difficult in preschool education due to the children's young age. Therefore, we focused on assessing the outputs by using SMART criteria – specific (describes an action, behavior, outcome, or achievement that is observable), measurable (details quantifiable indicators of progress towards meeting the goal), audience (is meaningful, realistic, and ambitious; the audience can), relevant and time-bound (delineates a specific time frame) (NAAEE, 2000). This is why the questionnaire had two parts. The first part involved the pedagogue evaluating a set of activities designed by the authors. The second part involved the pedagogue's self-evaluation of their implementation in class, including assessing the achieved outputs.

To evaluate the set of activities, we analyzed teachers' responses across 19 criteria. For criteria 1-14, we assessed all kindergartens, while for questions 15-19, only those who completed the set of activities were included in the analysis. This is because some kindergartens were unable to complete the set of activities due to COVID-19 measures.

Statistical analysis

A simple item analysis was performed for each item in the questionnaire. This analysis consisted mainly of determining the average rating of each criterion (items 1-19 of the questionnaire, see Appendices) and determining the average achievement rate of each output (questions in item 20). For the purposes of statistical processing, the criterion ratings are treated as a numerical variable (points).

In addition, differences in the criteria ratings and the achievement rate of each output between classes that completed all activities and other classes were evaluated. For these purposes, a non-parametric Mann-Whitney U test was used because of the discrete scales on which teachers rated the individual criteria and outputs.

The calculations were realized by R 4.3.1. The level of significance $\alpha = 0{,}05$ used in all tests.

3. Results

The research found that kindergarten teachers have positive attitudes toward a proposed set of activities. The results indicated that the set of activities received exceptionally high scores, with average scores for individual items ranging from 3.58 to 3.91 points (out of 4 points). The scores of individual items are presented in Figure 2. We also identified possible solutions, such as creating a reflection system, incorporating activities for reflection and conclusion, and reducing output requirements for groups with younger children. Additionally, we found that microgreen growth in kindergartens rates varied depending on factors like temperature and lid usage, which brought the need to adjust the plan during implementation according to the growth rate of the microgreens.

The activities were evaluated and analyzed based on the responses of those who participated. Two research questions were answered: one concerning the program's quality of program and the other concerning the quality of implementation. The survey revealed that kindergarten teachers had a positive attitude toward the set, with no statistically significant difference in the evaluation between teachers whose classes completed all activities and teachers who only managed a portion of the activities with children ($p > 0.05$ in all cases). The level of implementation was also high in individual kindergartens (see Table 2). It was found that the set of activities was very attractive to children and teachers, encouraging them to repeat it. Kindergartens that implemented all activities achieved higher outputs than those that implemented only microgreen cultivation (see Figure 3). However, only in the case of Output 2 and 3 are the differences between these groups statistically significant ($W = 56.5$, $p = 0.048$ for Output 2, and $W = 77.5$, $p = 0.007$ for Output 3, respectively). This finding shows that educational programs for preschool children should include comprehensive activities of various kinds.

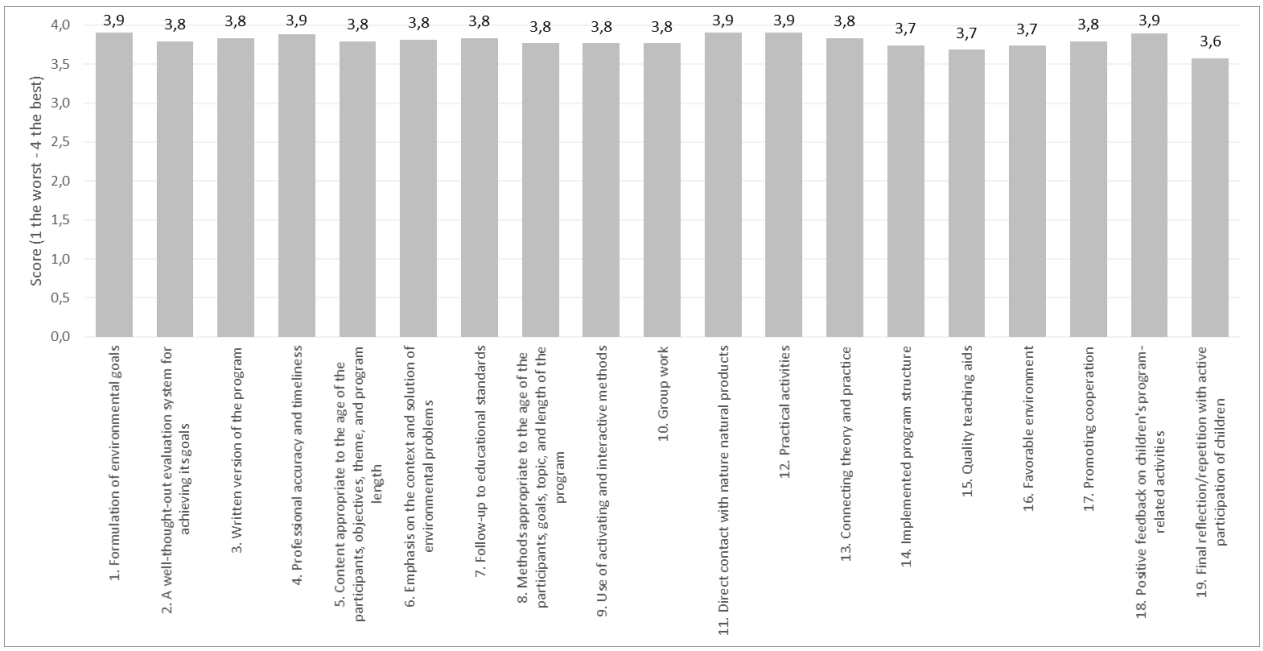

Fig. 2. Teachers' responses across 19 criteria

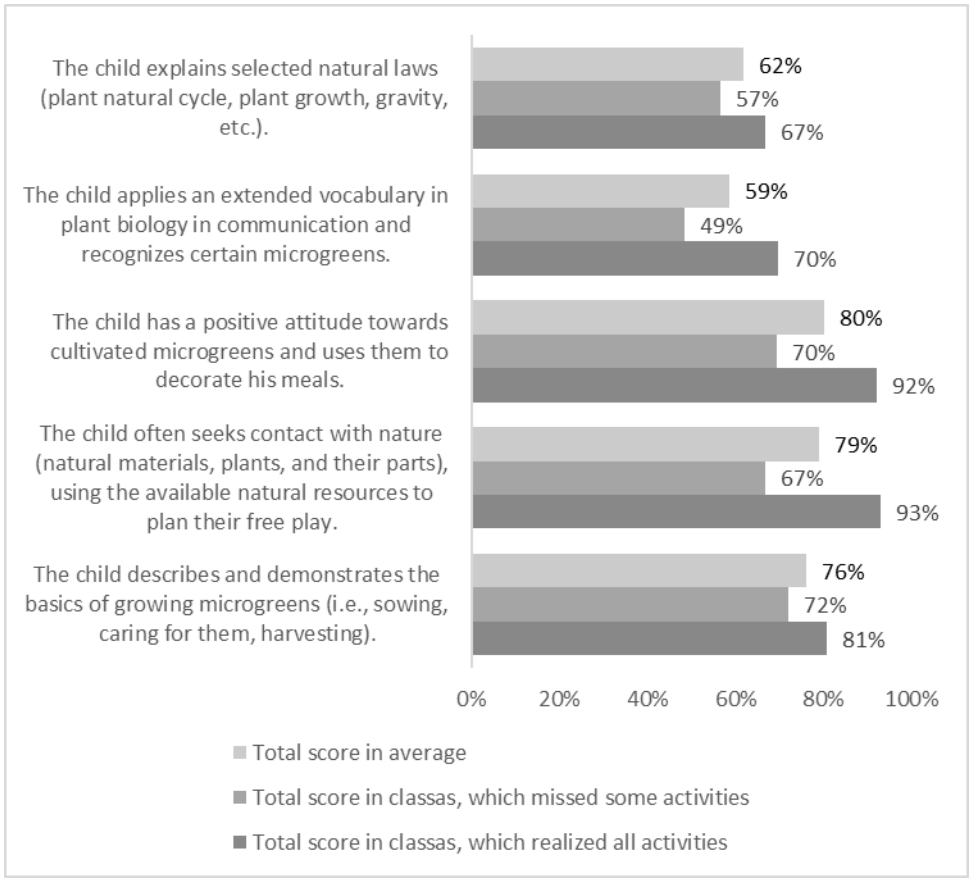

Fig. 3. Comparison of outputs according to the degree of completion

In general, we achieved the desired results for successful realization with most children, with at least half managing to accomplish all outputs. 74 % of children in each class achieved all expected results satisfactorily.

Respondents often noted that all the 5-6-year-olds achieved all outputs, while some of the younger children struggled with outputs related to their knowledge of names. According to teachers, these outputs were also unachievable for children with limited language skills.

The research produced several noteworthy findings. For instance, many respondents reported using the topic for distance learning (COVID) and being inspired to spend more time in their garden. We believe this could be useful for connecting families and kindergartens. Additionally, we discovered that growing microgreens indoors can be a meaningful activity for children with special needs.

While implementing a set of activities with an age-homogeneous group of three-year-old children, it is essential to remember that some younger children may only watch. Still, they are more likely to get closer to nature when they see adults interacting with it. The questionnaire survey results show that teachers can adapt the program for their children, even for classes with two-year-old children or rehabilitation hospital staff.

4. Discussion

Growing microgreens has positive effects on the overall development of a preschooler. This is consistent with the findings described earlier. Incorporating gardening and plants in environmental education is crucial, as studies have shown their benefits (Miller, 2007; Morgan et al., 2009). The mere presence of plants can positively impact health (Ulrich, 1984; Wells, Evans, 2003), enhance mood (Dopko et al., 2019), and create a more positive psychosocial classroom climate (Jančaříková, 2010). Additionally, plants in the environment foster cooperation and a sense of belonging among children (Cheng, Monroe, 2012) and can increase prosocial behavior (Dopko et al., 2019; Chang et al., 2016). Engaging in gardening activities can positively affect a child's development. For instance, gardening can improve a child's motor skills (Miller, 2007), enhance their overall well-being (Giraud et al., 2021), foster a sense of teamwork and school community (Robinson, Zajicek, 2005; Alexander et al., 1995; McMane, 2013; Bergan et al., 2021), and develop their problem-solving and social skills (Chang et al., 2016). Additionally, gardening can boost a child's literacy and mathematical abilities (Miller, 2007) as well as their scientific knowledge (Miller, 2007; Hasanah et al., 2019; López-Banet et al., 2022). Gardening activities can encourage children to try new foods (Chang et al., 2016; Bergan et al., 2021) and promote food literacy more broadly (Grubb, Vogl, 2019).

Microgreens are an ideal model organism for enhancing scientific literacy. In the Czech Republic, programs using animals – corn snakes (Jančaříková, 2020) and red-eared sliders (Lyžbická, 2020), as model organisms have been developed for preschoolers. These programs also included other activities besides activities with the model organism, but they had to be led by experts. The microgreens program, guided by the teacher, is a cost-effective and easy-to-manage program that does not require long-term responsibility. A study on programs foraging and gardening in kindergartens in Norway found that mutual engagement between children and teachers resulted in more learning and exploration than when external stakeholders were involved (Bergan et al., 2021).

In Spain, a set of activities using edible plants was developed to teach nutrition and scientific skills to preschoolers. Results showed that the students in the experimental group acquired essential scientific competencies related to plant foods and learned new scientific content while developing research skills (López-Banet et al., 2022). However, several barriers were identified, including a lack of materials, tiny garden space, limited activity time, teacher support and expertise, and a lack of understanding from school management, parents, and the public (López-Banet et al., 2022). Some similar barriers were also found by Burešová (2007): lack of enthusiastic teachers, poor material conditions, insufficient garden maintenance hours, and overwhelming student numbers. Interestingly, Rickinson (2004, as cited in Dyment, 2005) came with similar conclusions in research on barriers to outside learning: a lack of teacher understanding, self-confidence, and support, as well as fears of losing control and curriculum gaps. Growing microgreens eliminates many of these problems. This ensures the comfort and safety of the class and provides several benefits for the children. It is an easy and undemanding activity that can boost the confidence of teachers who wish to grow plants in the garden during spring. The set of activities also demonstrates that not many tools are required, and those can often be made from waste material. Additionally, it inspires incorporating plant cultivation into curricular documents to help achieve various goals related to school management.

Activities of this type help prevent Plant Blindness, which has biological and cultural causes (Wandersee, Schussler, 1999; Schussler, 2001). By teaching children about the importance of plants in the ecosystem and their daily lives, we aim to reduce plant blindness. Research has shown

that certain activities, such as gardening and plant-oriented programs, can lower plant blindness and that people who are more interested in plant-related activities tend to notice them more (Tunnicliffe, Reiss, 1999; Strgar, 2007; Patrick, Tunnicliffe, 2011; Amprazis, Papadopoulou, 2018; Pany, 2014; Comeau et al., 2019). Our efforts align with Sustainable Development Goal 15, which calls for protecting terrestrial ecosystems and preventing biodiversity loss. Plants play a vital role in achieving all 17 SDGs, and plant blindness can hinder attaining these goals (Amprazis, Papadopoulou, 2021).

Growing microgreens in a kindergarten can positively impact several Sustainable Development Goals (SDGs) (UNESCO, 2017). There is a direct link to SDG 4 Quality Education because this program is designed to align with the Czech curriculum and aims to educate children about plant growth, nutrition, and sustainability. SDG Goal 4 focuses on providing quality education and learning opportunities for all, including early childhood development, care, and pre-primary education (Goal 4.2) to prepare children for primary education. The goal also emphasizes the importance of promoting sustainable development through education. Goal 4.7 aims to equip learners with the knowledge and skills necessary to promote sustainable development, including sustainable lifestyles, human rights, gender equality, a culture of peace, and global citizenship.

Moreover, the program can empower SDG 3, Good Health and Well-being, as it teaches children how to grow food and live a healthy lifestyle, contributing to physical and mental well-being. The cultivation of microgreens is also connected to SDG 1, No Poverty, and SDG 2, Zero Hunger, as it can promote food security and good nutrition by teaching children about sustainable food production. SDG 12: Responsible Consumption and Production can also be addressed by reducing food waste through growing microgreens. Furthermore, SDG 13: Climate Action can be promoted by incorporating environmentally friendly gardening practices into the program. Learning about plants and gardening can also raise awareness about biodiversity and the importance of preserving terrestrial ecosystems, aligning with SDG 15: Life on Land. Finally, SDG 17: Partnerships for the Goals can be achieved through collaboration with local organizations, parents, and communities to support the microgreens project and contribute to achieving the SDGs through partnerships.

5. Limits of the study

Growing microgreens also includes some risks. Some young plants may be unsuitable due to toxic substances like tomatoes, potatoes, eggplants, and peppers (Parida, 2020). In the case of celiac disease, it is also essential to avoid barley. It is crucial to prioritize food safety and take necessary precautions.

According to the research, kindergarten teachers have a positive attitude towards the proposed set of activities and are highly aware of them. However, it is also crucial to consider the opinions of academics from pedagogical or science faculties towards these activities.

The research found that a group of teachers have positive attitudes toward a proposed set of activities, but we must say that the sample group had pre-existing interests. It may not be representative of the general population. Out of the 51 groups studied, 94 % grew plants and, 98 % focused on healthy eating, 85 % of the groups were involved in the initiative Truly Healthy School (*Skutečně zdravá škola*). Despite this limitation, the program is intended for teachers interested in growing plants with children (or sustainability), as this will ensure authentic and attractive pedagogical leadership for the children. It would certainly be suitable if workshops and training on sustainability were organized so that more teachers (not just those involved in similar initiatives) could get the knowledge they need. Engdahl et al. (2021) suggest that education for sustainability tends to be implemented by teachers who are deeply passionate about sustainability issues. Therefore, the critical approach is to inspire everyone to embrace sustainability, as demonstrated by the efforts of Semínko kindergarten.

6. Conclusion

Incorporating the growth of microgreens into kindergarten curriculums can serve as a valuable tool for promoting sustainable education.

Growing microgreens is just a tiny snippet of the many opportunities that Earth offers a child for learning. Growing microgreens in a kindergarten can be a good start in lifelong education for sustainability, LOHAS, and prevention of plant blindnes. We see many connections in the set of activities, especially regarding a healthy and quality life, science literacy, environmental feelings,

promoting sustainable cities, food selection and waste, the use of waste material, water consumption, and more. Growing microgreens offers many themes to discuss and provide opportunities for childrens' ideas and experiments.

The findings from this research study have the potential to inspire kindergarten teachers to create sustainable and environmental programs with program theory, to use the garden to grow food with children, and to implement lessons about nutrition and food consumption. The activity supports children's belief in a promising future and improves their ability to generate creative solutions that promote sustainable development.

References

Alexander et al., 1995 – *Alexander, J., North, M.W., Hendren, D.K.* (1995). Master gardener classroom garden project: An evaluation of the benefits to children. *Children's Environments*. 256-263.

Amprazis, Papadopoulou, 2018 – *Amprazis, A., Papadopoulou, P.* (2018). Primary school curriculum contributing to plant blindness: Assessment through the biodiversity perspective. *Advances in Ecological and Environmental Research*. 3(11): 238-256.

Amprazis et al., 2021 – *Amprazis, A., Papadopoulou, P., Malandrakis, G.* (2021). Plant blindness and children's recognition of plants as living things: a research in the primary school's context. *Journal of Biological Education*. 55(2): 139-154.

Ärlemalm-Hagsér, Sundberg, 2016 – *Ärlemalm-Hagsér, E., Sundberg, B.* (2016). Nature experiences and recycling - A quantitative study on education for sustainable development in Swedish preschools. *Nordina*. 12(2): 140-156.

Ärlemalm-Hagsér, Pramling Samuelsson, 2021 – *Ärlemalm-Hagsér, E., Pramling Samuelsson, I.* (2021). "Business as Usual"? Or Transformative and Transactive Teaching Leading towards the Agenda 2030 Goals in Swedish Early Childhood Education. *International Journal of Early Childhood Environmental Education*. 9(1): 94-111.

Bergan et al., 2021 – *Bergan, V., Krempig, I.W., Utsi, T.A., Bøe, K.W.* (2021). I want to participate—Communities of practice in foraging and gardening projects as a contribution to social and cultural sustainability in early childhood education. *Sustainability*. 13(8): 4368.

Brundtland, 1987 – *Brundtland, G.H.* (1987). Our Common Future: Report of the World Commission on Environment and Development. Geneva, UN-Dokument A/42/427. [Electronic resource]. URL: http://www.un-documents.net/ocf-ov.htm

Burešová, 2007 - *Burešová, K.* (2007). Učíme se v zahradě [Learning in the garden]. Kněžice: Chaloupky. [in Czech]

Carr et al., 2021 – *Carr, V., Elliott, S., Ärlemalm-Hagser, E.* (2021). Rethinking play in nature: Embracing early childhood education for sustainability. *International Journal of Early Childhood Environmental Education*. 9(1): 5-10.

Clark et al., 2020 – *Clark, S.J., Porath, S., Thiele, J., Jobe, M.* (2020). Action Research. Manhattan: New Prairie Press.

Comeau et al., 2019 – *Comeau, P., Hargiss, C.L., Norland, J.E., Wallace, A., Bormann, A.* (2019). Analysis of Children's Drawings to Gain Insight into Plant Blindness. *Natural Sciences Education*. 48(1): 1-10.

Daries et al., 2009 – *Daries, J., Engdahl, I., Otieno, L., Pramling Samuelsson, I., Siraj-Blatchford, J., Vallabh, P.* (2009). Early childhood education for sustainability: Recommendations for development. *International Journal of Early Childhood*. 41(2): 113-117.

Davis, 2009 – *Davis, J.* (2009). Revealing the research 'hole ' of early childhood education for sustainability: A preliminary survey of the literature. *Environmental Education Research*. 15(2): 227-241.

Davis, 2014 – *Davis, J.* (2014). "Are We There Yet? Early Education Responding to the Challenges of Climate Disruption and Sustainability". *Every Child*. 20(4): 24-25.

Davis, Elliott, 2014 – *Davis, J., Elliott, S.* (2014). Research in early childhood education for sustainability. International perspectives and provocations. London: Routledge.

Dopko et al., 2019 – *Dopko, R., Capaldi, C., Zelenski, J.* (2019). The psychological and social benefits of a nature experience for children: Apreliminary investigation. *Journal of Environmental Psychology*. 63: 134-138.

Dyment, 2005 – *Dyment, J.E.* (2005). Green school grounds as sites for outdoor learning: Barriers and opportunities. *International Research in Geographical & Environmental Education*. 14(1): 28-45.

Elliott, Davis, 2009 – *Elliott, S., Davis, J.* (2009). Exploring the resistance: An Australian perspective on educating for sustainability in early childhood. *International Journal of Early Childhood*. 41: 65-77.

Engdahl, Ärlemalm-Hagsér, 2014 – *Engdahl, I., Ärlemalm-Hagsér, E.* (2014). Education for sustainability in Swedish preschools. *Research in early childhood education for sustainability: International perspectives and provocations*. Pp. 208-224.

Engdahl et al., 2021 – *Engdahl, I., Pramling Samuelsson, I., Ärlemalm-Hagsér, E.* (2021). Swedish Teachers in the Process of Implementing Education for Sustainability in Early Childhood Education. *New Ideas in Child and Educational Psychology*. 1(1): 3-23.

Everage, 2002 – *Everage, L.* (2002). Understanding the LOHAS Lifestyle. *Gourmet Retailer*. 23(10): 82.

Furu, Heilala, 2021 – *Furu, A-C., Heilala, C.* (2021). Sustainability education in progress: Practices and pedagogies in Finnish early childhood education and care teaching practice settings. *International Journal of Early Childhood Environmental Education*. 8(2): 16-28.

Giraud et al., 2021 – *Giraud, E.G., El-Sayed, S., Opejin, A.* (28.08.2021). Gardening for Food Well-Being in the COVID-19 Era. *Sustainability*. 13(17): 9687. DOI: https://doi.org/10.3390/su13179687

Hägglund, Pramling Samuelsson, 2009 – *Hägglund, S., Pramling Samuelsson, I.* (2009). Early childhood education and learning for sustainable development and citizenship. *International Journal of Early Childhood*. 41: 65-77.

Howard, 2007 – *Howard, B.* (2007). LOHAS Consumers are Taking the World by Storm. *Total Health*. 29(3): 58.

Chang et al., 2016 – *Chang, Y., Tang, I., Chang, C.* (2016). Exploring the Benefits of School Gardening for Children in Taiwan and Identifying the Factors Influencing these Benefits. *HortTechnology hortte*. 26(6): 783-792.

Cheng, Monroe, 2012 – *Cheng, J.C.-H., Monroe, M.* (2012). Connection to Nature: Children's Affective Attitude Toward Nature. *Environment and Behavior*. 44(1): 31-49.

Jančaříková, 2010 – *Jančaříková, K.* (2010). Environmentální činnosti v předškolním vzdělávání [Environmental activities in preschool education]. Praha: Dr. Josef Raabe, s. r. o. [in Czech]

Jančaříková et al., 2024 – *Jančaříková, K., Kapuciánová, K., Kapuciánová, M.* (2024). Forest kindergartens in the Czech Republic. In J. Činčera, D. Zandvliet (Ed.), Building Bridges, Selected papers from the 11th World Environlental Education Congress (pp. 209–231).

Kapuciánová, 2021 – *Kapuciánová, K.* (2021). Pěstování microgreens v mateřské škole: Soubor aktivit pro mateřské školy [Unpublished manuscript]. Mateřská škola Semínko, o.p.s. [Electronic resource]. URL: https://www.toulcuvdvur.cz/files/a51eae248e0424024fc96334d65d049a.pdf [in Czech]

Kapuciánová, 2021a – *Kapuciánová, K.* (2021). Pěstování microgreens v mateřské škole [Growing microgreens in the nursery] [Master's thesis, Univerzita Karlova]. Digitální repozitář Univerzity Karlovy. [Electronic resource]. URL: http://hdl.handle.net/20.500.11956/125844

Kyriacou et al., 2016 – *Kyriacou, M.C., Rouphael, Y., Di Gioia, F., Kyratzis, A., Serio, F., Renna, M., De Pascale, S., Santamaria, P.* (2016). Micro-scale vegetable production and the rise of microgreens. *Trends in food science & technology*. 57: 103-115.

López-Banet et al., 2022 – *López-Banet, L., Rosique, J.M., Martínez-Carmona, M., Fernández, G.E.* (2022). Development of Food Competence in Early Childhood Education. *Education sciences*. 12(2): 64.

Lyžbická, 2020 – *Lyžbická, O.* (2020). Využití želvy nádherné v přírodovědném vzdělávání v mateřské škole, bachelor theses [Using the beautiful tortoise in science education in kindergarten] [Master's thesis, Univerzita Karlova]. Digitální repozitář Univerzity Karlovy. [Electronic resource]. URL: https://dspace.cuni.cz/handle/20.500.11956/116972 [in Czech]

McMane, 2013 – *McMane, E.W.* (2013). Growing empathy : an exploratory study on the effects of school gardens on children's social and emotional development: a project based upon an investigation at Berkeley Independent Study, Berkeley, California [Master's thesis, Smith College Karlova]. Smith Scholar Works. [Electronic resource]. URL: https://scholarworks.smith.edu/theses/627/?utm_source=scholarworks.smith.edu%2Ftheses%2F627

Miller, 2007 – *Miller, D.L.* (2007). The Seeds of Learning: Young Children DevelopImportant Skills Through Their Gardening Activities at a Midwestern Early Education Program. *Applied Environmental Education and Communication*. 6(1): 49-66.

Morgan et al., 2009 – *Morgan, S.C., Hamilton, S.L., Bentley, M.L., Myrie, S.* (2009). Environmental education in botanic gardens: Exploring brooklyn botanic garden's project green reach. *The Journal of Environmental Education*. 40(4): 35-52.

MŠMT, 2021 – MŠMT. Vývojová ročenka školství 2010/11 – 2020. MŠMT, 2021. [Electronic resource]. URL: https://www.msmt.cz/vzdelavani/skolstvi-v-cr/statistika-skolstvi/vyvojova-rocenka-skolstvi-2010-11-2020-21

MŽP, 2011 – MŽP. Cíle a indikátory pro environmentální vzdělávání, výchovu a osvětu v České republice [Objectives and indicators for environmental education and awareness in the Czech Republic]. Praha: Ministerstvo životního prostředí, 2011. [in Czech]

NAAEE, 2000 – NAAEE. Nonformal Environmental Education Programs: Guidelines for Excellence. Washington, DC: North American Association for Environmental Education, 2000.

Opravilová, Uhlířová, 2017 – *Opravilová, E., Uhlířová, J.* (2017). Příběhy české mateřské školy: vývoj a proměny předškolní výchovy. 1. díl do roku 1948 [Stories of the Czech kindergarten: the development and transformations of pre-school education]. Praha: Univerzita Karlova, Pedagogická fakulta. [in Czech]

Pany, 2014 – *Pany, P.* (2014). Students' interest in useful plants: A potential key to counteract plant blindness. *Plant Science Bulletin*. 60(1): 18-27.

Parida, 2020 – *Parida, S.* (2020). Innovative Farming of Edible Micro Greens at Home and their Nutritional Composition. *TEST Eng. and Manag*. 83: 17630-17640.

Patrick, Tunnicliffe, 2011 – *Patrick, P., Tunnicliffe, S.D.* (2011). What plants and animals do early childhood and primary students' name? Where do they see them? *Journal of Science Education and Technology*. 20: 630-642.

Pavučina SSEV, 2022 – Pavučina SSEV. Kdo jsme, materiály ke stažení [Who we are, download materials]. 2022. [Electronic resource]. URL: http://www.pavucina-sev.cz/rubrika/85-kdo-jsme-MATERIALY-KE-STAZENI/index.htm [in Czech]

Robinson, Zajicek, 2005 – *Robinson, C.W., Zajicek, J.M.* (2005). Growing Minds: The Effects of a One-year School Garden Program on Six Constructs of Life Skills of Elementary School Children. *HortTechnology*. 15(3): 453-457.

Roberts, 2010 – *Roberts, J.M.* (2010). LOHAS Consumers Around the World. *Lohas Journal*. 1: 11-45.

Rossi et al., 2004 – *Rossi, P.H., Lipsey, M.W., Freeman, H.E.* (2004). Evaluation. A Systematic Approach. London: SAGE Publications.

Schussler, 2001 – *Schussler, E.E.* (2001). Toward a theory of plant blindness/JH Wandersee, EE Schussler. *Plant Science Bulletin*. (47): 2-7.

Strgar, 2007 – *Strgar, J.* (2007). Increasing the interest of students in plants. *Journal of Biological Education*. 42(1): 19-23.

Strejčková, 2005 – *Strejčková, E.* (2005). Děti, aby byly a žily [Children to be and live]. Ministerstvo životního prostředí. [in Czech]

Treadwell et al., 2020 – *Treadwell, D.T., Hochmuth, R., Landrum, L., Laughlin, W.* (2020). Microgreens: A New Specialty Crop: HS1164. rev. 9/2020. *Edis*. 2020(5). [Electronic resource]. URL: https://journals.flvc.org/edis/article/download/123356/124773

Tunnicliffe, Reiss, 1999 – *Tunnicliffe, S.D., Reiss, M.J.* (1999). Building a model of the environment: how do children see plants? *Journal of Biological Education*. 172-177

Ulrich, 1984 – *Ulrich, R.S.* (1984). View through a window may influence recovery from surgery. *Science*. 224(4647): 420-421.

UNESCO, 2017 – UNESCO. Sustainable Development Goals. 2017. [Electronic resource]. URL: http://www.un.org/sustainabledevelopment/

United Nations, 2015 – United Nations [UN]. (Transforming our world: The 2030 agenda for sustainable development. UN General assembly, 2015.

Vogl, 2019 – *Vogl, C.R.* (2019). Understanding Food Literacy in Urban Gardeners: A Case Study of the Twin Cities, Minnesota. *Sustainability*. 11(13): 3617.

VÚP, 2021 – VÚP. Rámcový vzdělávací program pro předškolní vzdělávání stažení [Framework curriculum for pre-school education download]. Praha: MŠMT, 2021. [Electronic resource]. URL: https://www.msmt.cz/file/56051/ [in Czech]

Wandersee, Schussler, 1999 – *Wandersee, J.H., Schussler, E.E.* (1999). Preventing plant blindness. *The American biology teacher*. 61(2): 82-86.

Wals et al., 2017 – *Wals, A., Weakland, J., Blaze Corcoran, P.* (2017). Introduction. In P. Blaze Corcoran, J. Weakland & A. Wals (Eds.). Envisioning futures for environmental and sustainability education (pp.19-29). Wageningen Academic Publishers.

Wells, Evans, 2003 – *Wells, N., Evans, G.* (2003). Nearby Nature: A Buffer of Life Stress among Rural Children. *Environment and Behavior*. 35(3): 311-330.

Xiao et al., 2012 – *Xiao, Z., Lester, G., Luo, Y., Wang, Q.* (2012). Assessment of Vitamin and Carotenoid Concentrations of Emerging Food Products: Edible Microgreens. *Journal of Agricultural and Food Chemistry*. 60(31): 7644-7651.

Appendix

Questionnaire

Information about school/class:						
Date:		Present children: Composition of children: homogeneous / heterogeneous				
School:		We usually grow plants in kindergarten: yes / no				
Pedagogue:		In kindergarten, we usually focus on healthy eating: yes / no				
1) Pedagogue evaluating the set of activities itself:						
Monitored area	Evaluating criteria	Rating scale (4 best, 1 worst)				Space for additional comment
Planning and preparation	1. Formulation of environmental goals (appropriate formulation, environmental dimension).	4	3	2	1	
	2. A well-thought-out evaluation system for achieving its goals.	4	3	2	1	
	3. Written version of the program.	4	3	2	1	
Content	4. Professional accuracy and timeliness.	4	3	2	1	
	5. Content appropriate to the age of the participants, objectives, theme, and program length.	4	3	2	1	
	6. Emphasis on the context and solution of environmental problems.	4	3	2	1	
	7. Follow-up to educational standards.	4	3	2	1	
Methods and forms	8. Methods appropriate to the age of the participants, goals, topic, and length of the program.	4	3	2	1	
	9. Use of activating and interactive methods.	4	3	2	1	
	10. Group work.	4	3	2	1	
	11. Direct contact with nature natural products.	4	3	2	1	
	12. Practical activities.	4	3	2	1	
Motivation	13. Connecting theory and practice.	4	3	2	1	
Structure	14. Implemented program structure (e.g., goal, motivation, activities, conclusion).	4	3	2	1	
2) Pedagogue self-evaluating realization in his class:						
Suitable	15. Quality teaching aids.	4	3	2	1	

conditions	16. Favorable environment.		4	3	2	1	
Interaction	17. Promoting cooperation.		4	3	2	1	
	18. Positive feedback on children's program-related activities.		4	3	2	1	
Feedback	19. Final reflection/repetition with active participation of children		4	3	2	1	
Outputs	20. Achieving goals - outputs (at how many children the percentage output was achieved)	The child describes and demonstrates the basics of growing microgreens (i.e., sowing, caring for them, harvesting).					
		The child often seeks contact with nature (natural materials, plants, and their parts), using the available natural resources to plan their free play.					
		The child has a positive attitude towards cultivated microgreens and uses them to decorate his meals.					
		The child applies an extended vocabulary in plant biology in communication and recognizes certain microgreens.					
		The child explains selected natural laws (plant natural cycle, plant growth, gravity, etc.).					
Activities	**21. What activities did you not realize and why?**						
Additional comments	**22. Additional comment on the program**						
	23. Additional comment on the implementation of this program						

Tables

Table 1. Logic chain designed by program theory

Inputs	Humane	Teacher, children, pedagogical team, school director, head of the kitchen, cooks, cleaning woman, and parents.			
	Financial	Normative school fees, sponsorship gifts, grants			
	Organizational	Tools, material, space, time			
Activities	1. activities with seeds	a) Species recognition			
		b) Creating mandalas			
		c) Recognition of sounds			
	2. Sowing microgreens	a) Weighing			
		b) Sowing			
		c) Experience with geotropism			
	3. Microgreens care	a) Watering			
		b) Growth observation			
		c) Poem with movement			
	4. Harvesting and tasting	a) Tasting			
		b) Harvesting			
		c) Production of flavored butter			
		d) Creating a herbarium			
	5. Composting	a) vermicomposting			
		b) Observation of compost loosening			
		c) Microgreens for birds			

Outputs	1. The child describes and demonstrates the basics of growing microgreens (i.e., from sowing through caring for them to harvesting).
	2. The child often seeks contact with nature (natural materials, plants, and their parts), using the available natural resources to plan their free play.
	3. The child has a positive attitude towards cultivated microgreens and uses them to decorate his meals.
	4. The child applies an extended vocabulary in plant biology in communication and recognizes certain microgreens.
	5. The child explains selected natural laws (plant natural cycle, plant growth, gravity, etc.).
Outcomes	a) acquisition of knowledge and skills needed to perform simple activities in the care of the environment while co-creating a healthy environment = Output 3 and Output 1
	b) creating an elementary awareness of the wider natural environment, its diversity, development, and constant change = Output 5, Output 4, Output 2
Impacts	development of competencies needed for environmentally responsible behavior, i.e., behavior that is in the given situation and given possibilities as favorable as possible for the current and future state of the environment (MŽP, 2011) to establish in the child an elementary awareness of the surrounding world and its events, the human impact on the environment – from the immediate environment to global issues of global reach – and to create an elementary basis for an open and responsible attitude of the child (human being) to the environment VÚP, 2021

Table 2. Outputs

Number of the class	Realized all activities?	Percentage of children reached Output 1 The child describes and demonstrates the basics of growing microgreens	Percentage of children reached Output 2 The child is more often looking for contact with nature	Percentage of children reached Output 3 The child has a positive attitude towards cultivated microgreens and uses them to decorate his meals.	Percentage of children reached Output 4 The child applies an extended vocabulary in the field of plant biology in communication and recognizes certain types of microgreens.	Percentage of children reached Output 5 The child explains selected natural laws (plant natural cycle, plant growth, gravity, etc.).
2	✓	100 %	100 %	100 %	90 %	75 %
5	✓	100 %	90 %	90 %	50 %	50 %
15	✓	100 %	100 %	100 %	50 %	100 %
23	✓	67 %	100 %	100 %	73 %	67 %
24	✓	90 %	80 %	90 %	80 %	60 %
40	✓	50 %	100 %	100 %	50 %	50 %
37	✓	90 %	95 %	80 %	85 %	90 %
42	✓	70 %	-	100 %	100 %	60 %
3	✓	60 %	80 %	70 %	50 %	50 %
Total score in classes, which realized all activities:		**81 %**	**93 %**	**92 %**	**70 %**	**67 %**
31	-	70 %	40 %	90 %	100 %	-
20	-	70 %	80 %	60 %	50 %	50 %
14	-	75 %	100 %	75 %	75 %	50 %
16	-	100 %	100 %	100 %	10 %	100 %

22	-	50 %	20 %	70 %	20 %	20 %
26	-	85 %	60 %	70 %	30 %	50 %
30	-	70 %	50 %	70 %	50 %	80 %
38	-	60 %	60 %	50 %	50 %	50 %
45	-	50 %	90 %	40 %	20 %	50 %
17	-	90 %	-	70 %	80 %	60 %
Total score in classes that missed some activities:		**72 %**	**67 %**	**70 %**	**49 %**	**57 %**
Total score in all classes that finished the program:		**76 %**	**79 %**	**80 %**	**59 %**	**62 %**

The authors report there are no competing interests to declare.

The Czech company Skutečně zdravá škola (Truly Healthy School) has approved the implementation of the activity.