Revista ARACÊ
ISSN: 2358-2472

EXPERIENCE REPORT: AQUAPONICS WORKSHOPS FOR MUNICIPAL PUBLIC SCHOOLS IN BELO HORIZONTE, BRAZIL. WHAT DO EDUCATORS KNOW ABOUT AQUAPONICS?

https://doi.org/10.56238/arev6n3-164

Submitted on: 13/10/2024 **Publication date:** 13/11/2024

Alexandre Benvindo de Sousa[1], Daniela Chemim de Melo Hoyos[2] and Leonardo Campos Vieira[3]

ABSTRACT

The EcoEscolaBH program is an environmental education program of the municipal school system of Belo Horizonte, Brazil. In partnership with the Technical School of High School of UFMG and the School of Veterinary Medicine of UFMG, two short-term training workshops were offered on the potential use of aquaponics in educational activities. Eighty-nine kindergarten and elementary school teachers participated in the workshops. Diagnostic forms were made available to educators at the beginning and end of each workshop to assess their perceptions before and after the workshops and the possible impact of changing these perceptions. A descriptive analysis of these two moments and the effectiveness of a short workshop to present an innovative pedagogical tool are discussed here.

Keywords: Aquaponics. Continuing education. Basic education. STEAM.

[1] COLTEC-UFMG , Belo Horizonte, Brazil
(abenvindo@teiacoltec.org).
Professor and researcher of Biology and Cell Biology at COLTEC-UFMG
LATTES: http://lattes.cnpq.br/8515538095145076
[2] UFMG Veterinary School, Belo Horizonte, Brazil
danichemim@gmail.com
Professor and researcher of Aquaculture at the Department of Animal Science of the Veterinary School of UFMG
LATTES: http://lattes.cnpq.br/8011783284366315
[3] UFMG Tech High School, Belo Horizonte, Brazil
vieiralc@teiacoltec.org
Agronomist, laboratory technician at COLTEC-UFMG
LATTES: http://lattes.cnpq.br/0797532490113674

Revista ARACÊ
ISSN: 2358-2472

INTRODUCTION

Aquaponics is the intercropping of vegetables and aquatic organisms. We can establish aquaponics as an unnatural ecosystem by combining aquaculture and hydroponic crops. As an integrated method of farming, the components: plants, fish and bacteria cooperate with each other, providing a highly productive closed-loop system with maximum wastewater treatment and reuse. It is a synergistic and environmentally conscious way of producing food in a small space and with sustainable use of water. In addition, it can be deployed in small facilities, rooms, and/or laboratories. Due to these characteristics, aquaponics has gained an important role as an eco-friendly technique suitable for farmers, hobbyists, and educators (Godek & Kotzen, 2019).

As an innovative and disruptive educational resource, aquaponics has been used in schools to develop skills at different levels and grades. Disciplines and content related to the natural sciences, mathematics, physics, social sciences, and languages are areas that can benefit from their use (Floyd, 2014; Junge *et al*, 2019; Sousa and Hoyos, 2023). Suitable for small areas, aquaponics is rapidly conquering educational institutions, from early childhood education to undergraduate courses, with a special focus on STEAM (*Science, Technology, Engineering, Arts and Mathematics*) and inquiry-based teaching approaches. In addition, due to its sustainable nature, the use of aquaponics in the school environment is particularly associated with the themes of the following UN Sustainable Development Goals (SDGs): 2 (Zero Hunger and Sustainable Agriculture), 4 (Quality Education), 11 (Sustainable Cities and Communities) and 12 (Responsible Consumption and Production).

In order to prepare educators and teachers for the use of aquaponics in the teaching and learning process, two training workshops were held in partnership with the municipal environmental education program (EcoEscola BH) of Belo Horizonte (Brazil). The objective was also to disseminate aquaculture as an economic and educational proposal. During the workshops, the perceptions and expectations of the educators in relation to the use of the technique were evaluated. Methodologies, basic guidelines, procedures, lesson plans and teaching materials were proposed. The workshops provided the means for teachers to enhance their teaching, their classes and their activities with a new, attractive and innovative technology, suitable for all types of educational institutions and at any level of social or economic reality.

Revista ARACÊ
ISSN: 2358-2472

MATERIAL AND METHODS

On September 20, 2023, two short-term continuing training workshops were held, the result of a partnership between the EcoEscola BH Program, the Technical College of UFMG (Federal University of Minas Gerais), COLTEC and the Veterinary School of UFMG. These workshops were held at COLTEC. The first workshop took place in the morning and was attended by 48 (forty-eight) and, in the afternoon, with 41 (forty-one) educators who work in early childhood education, elementary school and high school. The training sessions consisted of different moments. First, before any presentation or information about the technique, educators were encouraged to answer a questionnaire about basic concepts of aquaponics and perspectives on the use of aquaponics in teaching and education. These diagnostic forms have been made available *online* on Google's forms platform , at the following link: <https://docs.google.com/forms/d/e/1FAIpQLSf7gHYEi4Y_JcAnUGwypo7_zT9kZYXFRQIdt1SLsVuRevEZ2w/viewform?usp=sharing> (in Portuguese). The responses to the forms were voluntary and anonymous. The following topics were evaluated: how long the educators' careers, at what level of education they work, what are the expectations for the use of aquaponics in institutions and in which areas or disciplines aquaponics could fit.

Figure 1- Aquaponics workshop at UFMG. September 2023.

In the second moment, the coordinators gave a lecture on theoretical concepts, technical aspects of the assembly of the systems and their use in educational activities (figure 1). The participants made a technical visit to the aquaponic systems installed in the COLTEC greenhouse (figure 2). At the Technical College, aquaponic systems have been

Revista ARACÊ
ISSN: 2358-2472

designed specifically for educational purposes and serve as demonstrative models for schools. During this visit, the concepts presented above were revisited and the operation and management of aquaponic systems were presented.

Then, the educators were encouraged to propose educational activities with aquaponics as the main theme. In this activity, educators had to fill in the following fields: title, subjects or areas, description of the activity and establishment of the objectives and skills addressed. The activity was made available at the following link: <https://docs.google.com/forms/d/e/1FAIpQLSc_IM6WW0xwVvhp_Lr8iXIp9vG3NR8U0O5ZhSVcYIfaoirLWw/viewform?usp=sharing>Finally, to assess whether there was a change in the educators' concepts and expectations, a last diagnostic form was filled out by the educators at the end of the workshop <https://docs.google.com/forms/d/e/1FAIpQLSdekY_dJ2AhiAFLq_9o0OID45VgBJJHh1Q9LN4yZbxCWXMVVA/viewform?usp=sharing>. The analysis between the first moment and the final moment was qualitative and descriptive.

Figure 2 - Educators visiting aquaponic systems at COLTEC-UFMG.

Considering the activities proposed by the educators, they were reported without value judgment.

RESULTS AND DISCUSSION

Among the educators who participated in the workshops, 53 (fifty-three) answered the two diagnostic forms. Sixty educators presented proposals for activities. Socioeconomic data show that most of them work in early childhood education and/or elementary school, and 86% work only in public schools. Considering the socioeconomic level of their students,

Revista ARACÊ
ISSN: 2358-2472

educators estimate that 79.7% belong to classes C, D and E (income ranges defined by the IBGE - Brazilian Institute of Geography and Statistics).

The answers and comparisons between the beginning and the end of the workshop are shown in Table 1.

Table 1. Questions and answers from educators at the beginning and end of the workshops about their expectations regarding the use of aquaponics in school.

Question	In the beginning	At the end
After the workshop, would you use aquaponics in school activities?	53.4% With sezeza 24.7 % Not sure 21.9% Don't know how to answer	52.8% Sure 32.1 % Not sure 15.1% Don't know how to answer
Is the use of aquaponics in line with the curriculum of your school or school network?	45.2% Yes, totally agree. 35.6% Yes, in part 16.4% Don't know how to answer 2.8% Not	52.9% Yes, totally agree. 34% Yes, in part 11.3% Don't know how to answer 1.9% Not
What is the main purpose of using aquaponics in school projects? (educators could check more than one alternative)	Educational resource 93.2% Ornamentation Feature 26% Hobby 24.7%	Educational resource 96.2% Ornamentation Feature 30.2% Hobby 30.2%
Which subjects or school areas could benefit from aquaponics?	Natural Sciences 65.8%. Languages 16.4% Physical Education, Arts and Social Sciences 2.7% each Other 16.4%	Natural Sciences 58.5%. Languages 7.5% Physical Education, Arts and Social Sciences 11.3% each Mathematics 1.9% Other 18.9%

As the evaluations presented here are qualitative and descriptive, a comparative analysis between the beginning and the end of the workshops shows a change in the perspectives of the participants, even if the meeting was short. As for the question of whether or not they would use aquaponics as an active, there was little variation for those who said they would definitely use it. However, in two groups: those who do not know whether they will use it or those who do not know how to answer the question, there have been changes. Our hypothesis is: with a better knowledge of the potential, risks and daily management of the system, the participant becomes more critical and careful to decide positively whether or not to use the technique. The main changes occurred in issues related to school curricula and programs and aquaponics, as well as the areas and disciplines that could benefit from the use of the asset. At first, 80.8% thought there was a connection (total

Revista ARACÊ
ISSN: 2358-2472

or partial) and, in the end, this number rose to 86.9%. Among those who did not know how to answer, there was a reduction from 16.4% to 11.3%. In the field related to areas and disciplines, the Natural Sciences were predominant in both moments, although with a reduction at the end of the workshop. It is important to note that other areas also appeared in the proposals, such as geography, entrepreneurship, mathematics, arts, biology and history. There was a significant alternation of values in the areas of languages and arts. Arts was mentioned by 2.9% initially. In the end, this number was 11.3%. The reduction in the language area should not mean a rejection of the area, but the opening of a new range of options. We attribute these changes, once again, to better knowledge about aquaponics.

When evaluating the proposed activities, there were simple titles, such as: "Aquaponics" and 'Aquaponics at school', as well as more elaborate titles, such as: "Observing our vegetable garden", 'Aquaponics and the seasons', or even 'Nutrients in rotation' and 'The magical world underwater'. In general, the educators showed motivation to propose innovations in the school routine, with aquaponics as the main theme.

We could see that, after participating in the workshops, the participants expanded the scope of the potential and applicability of the use of aquaponics in its contents and pedagogical uses.

CONCLUSIONS

Offering short-term aquaponics workshops to teachers and educators in schools in Belo Horizonte was a suitable strategy for aquaponics training.

The use of theoretical moments and technical visits was successful in involving the participants with the activities developed in the workshops.

Even short-term workshops influence transforming perceptions and concepts about aquaponics, an innovative area that is not yet widely disseminated or widely known.

ACKNOWLEDGMENTS

The authors would like to thank the board of directors of the Technical College of UFMG, Piscicultura Igarapé and the EcoEscolaBH Program for their support in carrying out the workshops.

Revista ARACÊ
ISSN: 2358-2472

REFERENCES

1. ECOESCOLABH. Prefeitura Municipal de Belo Horizonte. (n.d.). Disponível em: https://www.ecoescolabh.com/ Acesso em: 28 out 2024.

2. Floyd, M. (2014). Aquaponics for Teaching and Demonstration, Duval County, Florida (Master Project). Department of Agriculture Education and Communication, University of Florida. Disponível em: https://aec.ifas.ufl.edu/media/aecifasufledu/formsdocs/non-thesis-projects/Floyd_Final-NT-Project.pdf Acesso em: 28 out 2024.

3. Junge, R., Bulc, T. G., Anseeuw, D., Yildiz, H. Y., & Milliken, S. (2019). Aquaponics as educational tool. In S. Godek, A. Joyce, B. Kotzen, & G. M. Burnell (Eds.), Aquaponics Food Production Systems: Combined Aquaculture and Hydroponic Production Technologies for the Future (pp. 315-327). Springer Cham. Switzerland: Springer Open (e-book). Disponível em: https://doi.org/10.1007/978-3-030-15943-6_22 Acesso em: 28 out 2024.

4. Maucieri, C., Forchino, A. A., Nicoletto, C., Junge, R., Pastres, R., Sambo, P., & Borin, M. (2018). Life Cycle Assessment of a Micro Aquaponic System for Educational Purposes Built Using Recovered Material. Journal of Cleaner Production. Disponível em: https://pubag.nal.usda.gov/catalog/6137026 Acesso em: 28 out 2024.

5. Mullins, C., Nerrie, B., & Sink, T. D. (2015). Principles of Small-Scale Aquaponics (SRAC publication 5007). Disponível em: http://aquaculture.ca.uky.edu/sites/aquaculture.ca.uky.edu/files/srac_5007_prinicples_of_small-scale_aquaponics.pdf Acesso em: 30 out 2024.

6. Pattillo, D. A. (2017). Building and Caring for a Miniature Aquaponics System. Iowa State University, Outreach and Extension Center. Disponível em: https://store.extension.iastate.edu/product/Building-and-Caring-for-a-Miniature-Aquaponics-System Acesso em: 30 out 2024.

7. Pattillo, D. A. (2017). An Overview of Aquaponic Systems: Aquaculture Components. NCRAC Technical Bulletins, 20. Iowa State University Extension and Outreach Technical Bulletin #123, March. Disponível em: https://dr.lib.iastate.edu/server/api/core/bitstreams/786f5f75-b574-41ce-9d4b-d002376ec7c2/content Acesso em: 15 out 2024.

8. Pattillo, D. A. (2017). An Overview of Aquaponic Systems: Hydroponic Components. NCRAC Technical Bulletins, 19. Iowa State University Extension and Outreach Technical Bulletin. Disponível em: http://lib.dr.iastate.edu/ncrac_techbulletins/19 Acesso em: 15 out 2024.

9. Recsetar, M., & Kelly, A. (2016). Building a Simple At-home Aquaponics System (SRAC Southern Regional Aquaculture Center Publication No. 5010). Disponível em: https://srac-aquaponics.tamu.edu/categories/view/1 Acesso em: 27 out 2024.

10. Sousa, A. B. De, & Melo-Hoyos, D. C. (2023). Aquaponia: Uma ferramenta inovadora para o ensino de ciências. In Seven Editora (pp. 463-468). Disponível em:

Revista ARACÊ
ISSN: 2358-2472

http://sevenpublicacoes.com.br/index.php/editora/article/view/1224 Acesso em: 23 jun 2024.

11. Vujovic, A., Todorovic, P., Stefanovic, M., Vukicevic, A., Vaskovic, Jovanovic, M. V., Macuzic, I., & Stefanovic, N. (2019). The Development and Implementation of an Aquaponics Embedded Device for Teaching and Learning Varied Engineering Concepts. International Journal of Engineering Education, 35(1A), 88–98. Disponível em: https://www.ijee.ie/latestissues/Vol35-1A/09_ijee3701.pdf Acesso em: 28 out 2024.