PhD DISSERTATION PROJECTS

**Evaluation, development and implementation of a mobile application as an educational and empowerment tool to promote healthy and sustainable diets in university students**

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This PhD thesis research project aims to promote healthy and sustainable diets and reduce food waste in university students through the realization of a mobile application that detects consumption in university canteens in Parma with a Computer Vision system and provides tailored nutritional recommendations that also aims to improve food literacy and food-neophobia. The PhD is founded by ON Foods - Research and innovation network on food and nutrition Sustainability, Safety and Security – Working ON Foods[[1]](#footnote-1)

**Valutazione, sviluppo e implementazione di una applicazione mobile come strumento educativo e di empowerment per promuovere diete sane e sostenibili negli studenti universitari**

Questo progetto di tesi di dottorato mira alla promozione di diete sane e sostenibili e alla riduzione di sprechi alimentari in studenti universitari attraverso la realizzazione di una applicazione mobile che rilevi i consumi nelle mense universitarie con un sistema di Computer Vision e fornisca indicazioni nutrizionali personalizzate atte anche a migliorare la food-literacy e la food-neophobia.

# **1. State-of-the-Art**

Worldwide overweight and obesity has nearly tripled since 1975 (WHO, 2021). At least 2.8 million people die each year as a result of being overweight or obese, and an estimated 35.8 million (2.3%) of global DALYs are caused by overweight or obesity (Dai *et al.*, 2020). Public health systems are under increasing pressure from non‑communicable diseases (NCDs) including obesity, diabetes, heart disease and some cancers. At the same time, food systems are a substantial contributor to climate change, biodiversity loss and the depletion of natural resources. Changes in food systems are needed not only to address the rise in diet‑related NCDs, but to promote a shift towards an environmentally sustainable future.

Mediterranean diet (MD) is a milestone to aim for by reducing mortality in the general population and is also associated with low environmental impact (Tilman and Clark, 2014). In last decades adherence to MD decreased in Mediterranean countries, resulting in a rise of western dietary pattern (associated with a greater environmental impact and a higher risk of NCDs). To reverse this trend, innovative educational models are needed to promote healthy and sustainable diets in specific populations. Supportive environments and communities are fundamental in shaping people’s choices, by making healthier foods and regular physical activity the easiest choice (the most accessible, available and affordable), and therefore preventing overweight and obesity. Moreover, to influence food choices, there is a need to identify and understand determinants of people’s behavior focusing both on the interpersonal level and the food environment, which refers to the physical, economic, socio-cultural and policy conditions that shape access, affordability, safety, and food preferences and includes the social network, physical context, and policy-related factors (*The Factors That Influence Our Food Choices*). People more conscious of current environmental issues are more prone to shift toward more sustainable eating habits. Therefore, increasing peoples’ literacy about health and environmental impact of food systems seems to be a promising strategy for raising awareness and building the capacity to adopt food practices that enhance health and well-being.

A mobile application called NUBI (NUtrizione BImbi) has been developed and tested in Parma (Rosi *et al.*, 2016). Parents of children attending primary schools in Parma were given nutritional advice and suggestions for dinners and weekends in relation to what their children ate at school. Currently in literature there are not many validated models that uses new technologies recognized as effective in changing eating habits. Nevertheless, their main potential to enhance dietary assessment is through more cost- and time-effective, less laborious ways of data collection and higher subject acceptance (Illner *et al.*, 2012). Recently, Computer Vision for food recognition (by using Convolutional Neural Networks) have had a big step forward, achieving about 79% of food and tray recognition accuracy (Ciocca, Napoletano and Schettini, 2017). Computer vision could be implemented in university canteens in Parma to assess food consumption and based on it, provide customised nutritional and environmental recommendations to students. The use of a mobile application as a communication tool to convey educational content in terms of nutrition and sustainability, together with the improvement of the food offer and the implementation of a supportive environment, could make university canteens a strategic setting to advocate healthy and sustainable nutrition in both university staff and students (Krattenmacher *et al.*, 2023).

**2. PhD Thesis Objectives and Milestones**

Within the overall objective mentioned above this PhD thesis project can be subdivided into the following activities according to the Gantt diagram given in Table 1:

A1) Literature review of educational models (A1.1) aimed to drive people to healthy and sustainable diets.

A2) Food consumption habits, food choices and plate waste (A2.1), nutrition and food sustainability knowledge (A2.2) of Parma University students attending the University cafeteria will be investigated to obtain a baseline reference.

A3) The educational material, the tools, and information on the food offered in the canteen will be made available to the students in a digital application (A3.2) the customization of which could be addressed thanks to the support of UNIMIB (A3.1).

A4) After discussion about feasibility with the caterer, optimized menus (A4.1) will be developed with the use of more sustainable recipes, together with the dining rooms re-designed (A4.2) to promote users’ engagement and increase students’ literacy.

A5) During and after the intervention the same outcome variables food consumption habits, food choices and plate waste (A5.1), nutrition and food sustainability knowledge (A5.2) will be monitored to assess the efficacy of the intervention itself.

A6) Writing and Editing of the PhD thesis, scientific papers and oral and/or poster communications.

***Table 1***Gantt diagram for this PhD thesis project.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| Activity Months | | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** |
| A1) | ***Educational models*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1) Literature review |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A2) | ***Baseline assessment*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1) Consumption and waste |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2) Sustainability habits |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A3) | ***Mobile application*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1) App customization |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2) Educational material |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A4) | ***Environment optimization*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1) Optimization of menu |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2) Dining room design |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A5) | ***Intervention assessment*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 1) Consumption and waste |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  | 2) Sustainability habits |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| A6) | ***Thesis and Paper*** |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

**3. Selected References**

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