

Science of Cooking - Learning STEM subjects through cooking for persons with intellectual disabilities

Learning Approach



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Science

Table of contents

- 01 1. Introduction
- 02 Project Partners

03 2. People with intellectual disabilities

- 07 a) Adult people with intellectual disabilities
- 09 3. Learning strategies and methods for adults with intellectual disabilities
- 11 a) Learning by doing approach
- 13 b) Group work
- 14 c) Easy to read language
- 15 c1) Easy to read rules
- 18 4. Competences educators should have to work with people with intellectual disabilities
- 20 5. Cooking as a teaching tool

23 6. Sustainability & Green practices

- a) Seasonality of food
- 24 a1) The double pyramid connecting health, food and sustainability
- b) Food waste and loss
- 28 b1) Chemical and Physical Methods of food preservation
- 28 c) Packaging and recycling
- 30 d) How to use Leftover for balanced recipes



- 31 7. Safety in the kitchen
- 31 a) Kitchen safety
- 32 a1) HACCP
- 33 b) Accessible kitchen

35 8. STEM learning and education

- a) Cooking as a means in STEM education for adult persons with ID
- 36 a1) The science behind the cooking
- 38 b) Key competences and basic skills in the field of STEM that can be improved with cooking activities
- 40 b1) Mathematical competences
- 42 b2) Science competences
- 44 c) STEM topics to be addressed through cooking
- 44 c1) Talking about Physical Quantities and their Measurements
- 46 c2) Talking about the State of Matter and Phase Transformations
- 49 c3) Talking about Heat and Heat Transfer
- 52 c4) Talking about chemical compounds and chemical reactions
- 53 c5) Talking about biomolecules and nutrients
- 55 c6) Talking about Microorganisms

56 9.Tool to assess skills and competences of persons included in the learning activity

- a) Importance of assessment in educational process
- 61 b) Why are assessment tools important in the project Science of Cooking
- 62 c) STEM learning through cooking questionnaire with specified skills and competences for educators
- 62 d) STEM learning through cooking questionnaire for persons with intellectual disabilities
- 63 e) A Hero's journey

68 10. References





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1. Introduction

With a team of five organisations from four different countries, the Science of Cooking project is a European Erasmus+ KA2 project, aiming to provide social change, support, and improvement to the European Union and its member states. Through the project we want to focus on direct user engagement and involvement, having adults with intellectual disabilities directly participate in the project activities and events.

Our project uses the interactivity and observations possibilities of cooking to support adults with intellectual disability in learning more about STEM topics. STEM is a term commonly used for science, technology, engineering and math sectors mainly in education. It combines research, education, awareness, and exploration of the four areas. Through a kinesthetic and learn-by-doing approach to learning, cooking aids your teaching and learning about subjects like math, measuring, science, and other STEM areas.

In this result, we present you with a new approach to learning and teaching. We are providing you, as an educator or organisation, with the knowledge, method, and resources to improve the learning process of adults with intellectual disabilities. Using learning-by-observation and learning-by-doing as focus of the approach, we offer materials and information on how to successfully apply the new methodology in your practices.







Project Partners



Education Centre Geoss, Slovenia

Education centre focused on adult education. Conducts both formal and non-formal programmes for adults with 60 years of experience.



Zveza Sožitje, Slovenia Non-profit organization for persons with intellectual disabilities and their families.



Consultoría de Innovación Social, Spain Creating impact and sustainability by innovative approaches to solve existing social challenges and requirements.



Associazione culturale Eufemia, Italy

Social Promotion Association that works for social inclusion, through active citizenship actions and intercultural dialogue.



NOESIS – Thessaloniki Science Center and Technology Museum, Greece

Technology museum with planetarium, 3D simulator and large format theater.

Inspires and informs about STEM subjects.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



2. People with intellectual disabilities

There are many definitions of intellectual disability. They differ from each other depending on the scientific discipline from which they originate (medicine, psychology, special pedagogy, etc.).

Disability in intellectual development means generally below-average intellectual functioning, which occurs in the developmental period up to the age of 18 and is significantly linked to the individual's adaptation skills. Intellectual abilities refer to the ability to think, learn and solve problems. Adaptive skills are learned behaviors and include the individual's ability to adapt and manage the environment in order for the individual to function in accordance with social expectations. (Zveza Sozitje, 2021)

For successful schooling, they need special approaches and work methods based on their developmental abilities and problems - and, as a result, inclusion in suitable school programs.

In adulthood, to live as independently as possible, they need adapted forms of employment and support, help and adaptations for integration into the community. Many people with special needs need care, a high level of assistance and care throughout their lives.

A person with an intellectual disability is a person who, when tested, deviates significantly to below average in at least two of the following areas of adaptive behaviour: Communication, self-direction, self-care, health and safety, housework, time. finding oneself in free the environment. work and employment, academic functional skills. social interdisciplinary ability.

The success of progress in the development of the individual and the success of adapting the individual to the demands and expectations of the environment in which he lives depends on: degree of intellectual disability, timely detection, timely and appropriate early treatment, from the readiness of the environment to accept them as they are and to create suitable conditions for learning, living and working in which the individual satisfies his basic needs in the best way.







People with intellectual disabilities in their development follow the same laws as others, but with the difference that the development is much slower and that they show greater or lesser deviations in the mastery of individual skills and habits and in the development of abilities.

Development does not take place uniformly, and some stages of development occur at the same time (e.g., speech and motor development take place at the same time). In individual areas (speech, motor skills, social-emotional area, perception, etc.), deviations of various degrees are noticeable.

Discrepancies between chronological and mental development are noticeable. In persons with intellectual disabilities, peculiarities appear in the field of development of intellectual abilities due to:



The specific characteristics of people with intellectual disabilities during their development also apply to them in adulthood. When dealing with adults, it is very important to consider and respect their life experiences in addition to their characteristics

(Zveza Sozitje, 2021)





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



Petra / 30 years old.

She went to kindergarten at the age of 3. She preferred to be alone in kindergarten. She cooperated with her peers only if the teacher directed her. She had problems pronouncing individual sounds, so she visited a speech therapist. Her parents also worked a lot with her at home. It was only shortly before entering school that she mastered going to toilet and stopped using diapers.

Joining primary school with new classmates and greater demands caused Petra a lot of stress. She cried several times at school, she did not participate in the children's group play. In the first grade, with great efforts and strong encouragement from the teacher, speech therapist and parents, she barely reached the minimum standards of knowledge necessary to pass to the next grade. In the second grade, health problems and fear of school appeared. She often cried in the morning and asked not to go to school. Her parents took her for various treatments to specialists.

In the middle of the school year, they decided to transfer her to an elementary school with an adapted program. After only a few days, the girl came to life: she started talking, participating in lessons, and playing with her classmates. She successfully completed elementary school with an adapted program.

She then continued her education in a two-year customized vocational program. To successfully complete this, she needed a lot of support from professionals at the school and help from parents.

For quite some time, she looked for a job with the help of her family and found it in a medical institution, where she has been working as a seamstress's assistant in a laundry for several years now. She talks about her work with pride and loves going to work.

She likes to spend her free time in nature. A few years ago, she met a boy. With the help of their family, they arranged an apartment where they live independently. They need help with major and long-term life decisions.

Petra says that she is happy.





Jana / 45 years old

Jana is an adult woman, 45 years old. Together with her partner, who is also a person with an intellectual disability, she lives in an apartment.



When she was 7 years old, her parents enrolled her in an institution - that's what they said at the time. She was included in "training" (now we would say in a special education program). As a little girl, she was taught step-by-step and fragmented various self-care activities and household chores, she was also very successful in acquiring knowledge in other areas. She was very fond of music and dancing. She was successful in sports activities.

As a teenager, she took part in cross-country skiing competitions several times. She participated very successfully in the Special Olympics World Games twice. During her 18 years of schooling, she acquired the knowledge and skills necessary for everyday life, skills in the field of artistic and sports activities, and academic knowledge to the greatest extent possible.

She had some health problems since birth. At the age of three, she had her first epileptic seizure, and later and still has them several times a year. At the age of 16, she began to experience various anxieties, which were strongly reflected in her general functioning and behaviour. Since then, she has been regularly treated by a psychiatrist.

After the age of 26, she joined the Occupational Activity Centre. She learned to sew slippers in a sewing workshop. After a few years, she wanted a change and was included in a workshop in another place, also at the Occupational Activity Centre.

When the Centre opened an apartment complex, she expressed her desire to move, and she and her boyfriend moved there. In the residential group, she likes to help with cooking, arranging the house and surroundings. She especially likes to take care of flowers. She needs help and guidance at work. Jana also likes to go shopping. But not alone. She wants a person from the housing group next to her whom she trusts. Jana does not know the value of money and finds it difficult to find her way in the multitude of things on offer.

Jana is a contented middle-aged woman. She still likes to go for a walk with her partner, she no longer does sports. She also gained quite a few extra kilos. She enjoys watching TV serials. She spends the holidays and part of the holidays with her parents, who are 80 years old.







a) Adult people with intellectual disabilities

Adults with moderate, severe, and profound intellectual disabilities will never be completely independent and will need special care, help, guidance, direction, and support throughout their lives. Lifelong learning in different forms and in different ways is a constant for every person. It is especially important for people with intellectual disabilities because the processes of forgetting acquired knowledge take place much faster for them than for the majority of population. People with intellectual disabilities in adulthood need constant stimulation from the environment, encouragement, guidance and leadership to maintain what they have acquired and to acquire new skills, because their intellectual abilities are reduced and therefore they are unable to understand and anticipate the positive effects of learning on the individual; have reduced motivation skills, especially internal motivation; have reduced abilities in the areas of self-initiative; have reduced abilities in the area of their own orientation towards the environment.

In lifelong learning, we must treat people with intellectual disabilities as adults, considering their primary individual characteristics, life experiences, individual needs and rights. When working with them, we use andragogical work methods, namely: acquisition of functional skills, situational learning, social learning, and imitation.

Adults with intellectual disabilities can develop individual areas with appropriately designed organized activities that include opportunities for learning new content, skills, knowledge and habits, preservation and development of socialization, maintenance of already acquired habits, preserving, and developing independence, maintaining psychophysical condition, maintaining work capacity.

The doctrine of our work is a social model that looks for an individual's strong areas. The user is at the center, and our task is to look for such forms and methods of work, motivation and content that arise from the individual and his interests and abilities.

When working with adults, their free time is also important, which means relaxation, experiencing, creating and everything that outgrows, the limits of obligations and external demands.







We know creative leisure and alienated leisure. We all need one and the other, but it is typical for people with intellectual disabilities to be unable to organize themselves in most of their creative free time. Therefore, it is necessary to help them find and plan activities and opportunities for using their free time, or they also need to be taught this.

Adults with intellectual disabilities therefore need different levels of guidance, help and support. When giving support, we cannot be sure if it is right or if it is too much or too little, so as not to overdo it and cause excessive dependence or passivity in the person. An important criterion for assessing the appropriateness of the type or level of support is the level of satisfaction or dissatisfaction expressed by the person. As much help as needed and as little as possible is good







3. Learning strategies and methods for adults with intellectual disabilities

Adults with intellectual disabilities need special encouragement throughout their lives. While other people become independent as they grow up with appropriate education and external stimuli, people with intellectual disabilities need help throughout their lives. Therefore, people with intellectual disabilities need the opportunity and the right to lifelong learning even more. If they do not have this, they cannot develop properly and begin to gradually decline, and with this, all the knowledge already acquired in the past also declines. People with intellectual disabilities are constantly dependent, so they need someone to guide them to new interactions, because they cannot come to them by themselves or they do not have enough of their own initiative and ability to create them. (Novljan & Jelenc, 2000)

Adults with intellectual disabilities must be treated systematically and holistically. The help of family members, who have recently been increasingly included in the treatment, also contributes a lot. Adults with ID are a heterogeneous group with different abilities, which should always be considered when learning. (Lanfranchi & Carretti, 2024)

In the education of people with ID, the content that these people will need throughout their lives must be covered, and the teaching process of these people must be structured in such a way that their memory capacities are constantly activated and active. We achieve this by constantly providing, repeating, and intertwining all those important contents that are important for this population and enable them to be more actively integrated into the wider social environment. It makes sense that educational content is constantly renewed and relived through various periods of life. (Žgur, 2016)

If people with ID receive timely stimulating, encouraging and long-lasting educational content, with the gradual transfer of this content to the work-employment-functional sphere, suitable for their basic abilities and peculiarities, they will progress, experience success and self-confidence (Kobal Grum, Kobal, 2009). Therefore, it is necessary to establish permanent mechanisms of learning and training for people with ID and thus maintain the achieved learning-educational or process-working and occupational content.









A fundamental characteristic of adults with ID is that they will never be completely independent in their lives. They are about achieving a greater or lesser degree of independence and thus a higher or lower level of employment (or professional qualification). To achieve the greatest possible level of independence, we must not forget that at least three more components are necessary for their healthy, social-emotional development (Lačen, 2001): constructive activity: which every person achieves only if he does the things he can do (stimulating environment, suitable content and communication channels that enable communication), emotional satisfaction, personality confirmation.

(Lačen, 2001)

It is important that strategies are implemented which address the needs of the individual and that the strategies are used in the context of the home, school, and community. Some recommendations for the learning of people with ID.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



a) Learning by doing approach

There are several different approaches or terms that cover the wide variety of approaches to learning by doing such as experiential learning, co-operative learning, adventure learning and apprenticeship.

Learning by doing refers to a theory of education. It is a hands-on approach to learning, meaning learners must interact with their environment to adapt and learn. This way learning enables the learners with greater self-esteem, trust in their skills, capabilities, taking responsibility for their life, gaining working experiences, greater acceptance in social environments.

Learning is the process whereby knowledge is created through the transformation of experience.

Learning by doing is based on three assumptions:

- 1. People learn best when they are personally involved in the learning experience.
- 2. Knowledge has to be discovered by the individual if it is to have any significant meaning to them or make a difference in their behavior.
- 3.A person's commitment to learning is highest when they are free to set their own learning objectives and can actively pursue them within a given framework

(Ord, 2024)











According to Kolb's four-stage model of experiential learning, the effective learning is seen when a person progresses through a cycle of four stages: of (1) having a concrete experience followed by (2) observation of and reflection on that experience which leads to (3) the formation of abstract concepts (analysis) and generalizations (conclusions) which are then (4) used to test hypothesis in future situations, resulting in new experiences.

(Mcleod, 2024)

To navigate on the journey of lifelong learning the most important thing for individuals to learn is how to learn. Experiential learning theory (ELT) helps learners to understand how learning occurs, to see themselves as learners and the nature of the spaces where learning occurs. With this awareness, learners can live each successive life experience fully - present and mindful in the moment. The learning way, according to the experiential learning, is about approaching life experiences with a learning attitude.

(Pasarelli & Kolb, 2011)







b) Group work

Every educational event, like lifelong learning programs, has a goal. When working with a group of participants, however, it quickly becomes clear that simply focusing on the goal is not enough. When leading a group you have to pay attention not just to the goal but to the place (e.g., that it is sufficiently warm, pleasant), to ensure that no one is excluded from the group, special behaviours, your communication.



The group is formally together because of the task, but there is much more going on in it and sometimes this has the greatest impact on the execution of the task. Groups often focus on one area. Some individuals complain that they don't feel good in a group, some groups want a lot of time to socialize, but they don't do what they should...

Working with a group is an interweaving of three equal areas, which can be illustrated by three circles of equal size. When an individual is a part of a group, he or she wants to satisfy his/her needs in it (for belonging, for being heard, for security, etc.). He/she will stay in the group if he/she feels the goal that the group has, as long as he/she has enough people there with whom he/she is close, or as long as the purpose that the group can partially realize also means something to him/her. The relationship with other members of the group is important to him/her, especially those who are important to him/her, the relationship with the leader, well-being in the group, feeling of safety, acceptance, relaxation, activities, etc.

The group is like a living organism. The way the group operates is related to the nature of the task and the processes that take place in the group. We understand the meaning of the word task here in the broadest sense – it can be a concrete project that the group has (a camp, conducting a workshop, etc.), a conversation, a program that the trainer implements in the group, the design of a document, etc.

The connective tissue of these fields is shared beliefs, values, and ethics. Sometimes they are clearly present from the beginning. Sometimes people are united by a small common denominator, but in any case, they are formed and changed throughout the life of the group. They direct the work of the group and influence the norms within it. The clearer they are, the easier it is for the group to make decisions.

(Cepin, Kronegger, Muršec, Oblak, & Milenković Kikelj, 2014).







c) Easy to read language

Easy-to-read information is important for people with intellectual disabilities. It is important so they can learn new things, take part in society, know their rights, and stand up for them, make their own choices (Inclusion Europe, 2024). European declaration of the right to literacy, 2016, states every European citizen has the right to literacy. EU Member States should ensure that citizens of all ages, regardless of social class, religion, ethnicity, and gender, have access to the necessary sources of information and opportunities to become literate enough to effectively understand and use print or digital communication the media. All people have the right to education. This means that we all have the right to learn. We have the right to go to school. To learn, we must be literate. Every European citizen has the right to literacy. Literacy means that we have information and know how to use it.

The right to information is also enshrined in the Convention on the Rights of Persons with Disabilities. Article 9 talks about accessibility. The Convention states that all people have the right to information. People who have difficulty reading and understanding what they read have the right to easy reading.

(Inclusion Europe, 2024)







c1) Easy to read rules

Easy to read rules are taken from European standards for making information easy to read and understand.

(Inclusion Europe, 2024)

General standards for easy-to-understand information:

General

- Always find out as much as you can about the people who will use your information and about their needs.
- Choose the best format for your information.
- Always use the right language for the people your information is for. For example, do not use language for children when your information is for adults.
- Remember that the people who will use your information might not know much about your subject. Make sure you explain the subject clearly and explain any difficult words to do with that subject.
- Always involve people with intellectual disabilities when making your information.

Words

- Use easy to understand words that people will know well.
- Do not use difficult words. If you need to use difficult words, make sure you always explain them clearly.
- Use examples to explain things. Try to use examples that people will know from their everyday lives.
- Use the same word to describe the same thing throughout your document.
- Do not use difficult ideas such as metaphors. A metaphor is a sentence that does not actually mean what it says. An example of a metaphor is "it is raining cats and dogs".
- Do not use words from other languages unless they are very well known like the French word "voilà" in the English language.
- Avoid using initials. Use the word in full where possible. Initials are the first letter of every word. If you have to use initials, explain them. For example, if you write "EU", explain that it stands for "the European Union".



Sentences

- Always keep your sentences short.
- Speak to people directly. Use words like "you" to do this.
- Use positive sentences rather than negative ones where possible. For example, say "You should stay until the end of the meeting" rather than "You should not leave before the end of the meeting".
- Use active language rather than passive language where possible. For example, say "The doctor will send you a letter" not "you will be sent a letter".
- Always start a new sentence on a new line.
- Never split 1 word over 2 lines.

Design and format

- Use a format that is easy to read, follow and photocopy. For example, A4 or A5.
- Think about the size of your document. A book of 100 pages is too long. People could feel they are not able to read such a long book. In this case, it would be better to write 3 smaller booklets.
- Never use a design or layout that will make your document hard for people to read and understand. The most important thing is that your document is easy for people with intellectual disabilities to understand.
- Never use a background that makes it difficult to read the text. For example, never use a picture or a pattern as a background.



• Be careful when using a dark background. When you do that, make sure the background is dark enough and the writing clear enough for you to read it.

This is easy to read

This is not easy to read





Images

• Many people find it hard to read text. To help them understand your text, you should put images next to it to describe what it is about. You can use photographs, drawings, or symbols.

Writing

- Always use a font that is clear and easy to read.
- Never use serif fonts. These fonts are harder to read because the shape of the letters is not as clear.
- Always use large writing. You should use writing which is at least the size of Arial 14.







4. Competences educators should have to work with people with intellectual disabilities

Professional knowledge

The first of the skills that a mentor must have is certainly the professional knowledge, necessary to support the need for growth of the mentee. In order to help the mentee find the right answers, he/she will need to be equipped with acumen and insight into the business in order to guide him/her in the right direction. The sense of experience will serve even if the mentor has not had direct experience of the same problems. Through the example of the strategies he/she uses in similar cases, even negative ones, he/she will help the mentee to face mistakes, to take risks and become resilient.

Self-awareness

Self-awareness must be second among the skills. A mentor must know how to objectively observe his/her behaviour, wondering why such behaviour, analyse the consequences for yourself on others and for your goals and know how to change if necessary. Awareness is essential and is the basis of learning. And the mentor must be able to teach it to the mentee. So he/she will teach him to learn.

Understanding of others

It has been in trend for some time, but empathy is one of the necessary skills if you want to be a good mentor. Understanding the emotions of others, grasping body language, helping him/her manage his/her anxiety and fears. Be positive and encouraging. Knowing how to predict the consequences of a certain behaviour. Knowing how to give honest and constructive feedback. And to know how to receive them with humility.

Effective communication

Knowing how to listen carefully to what the other has to say. Without interrupting. Listening to the end and without anticipating the conclusions using pre-concepts (i.e. formulated before). Knowing how to manage silence and take advantage of it to grasp the non-verbal communication. And above all, knowing how to ask questions, so to push the mentee to find his solution.







Knowing how to build an engaging relationship based on trust

For the mentoring relationship to be successful, the mentor must have a positive influence on the mentee. And to be able to do so, he/she must have a sense of measure and be humble in reporting his/her successes or failures. He/she must have a sense of humour so that meetings are always pleasant. The mentor must respect the confidentiality and the most personal information he/she will collect during meetings and make good use of them. And he/she must confront without judging.

Interest in making others better and improving themselves

This predisposition in the mentor is necessary because he/she will have to be available and dedicate a lot of time to the mentee. Often only in exchange for some recognition, certainly not for money. And this interest must demonstrate this by supporting and accepting the objectives of the mentee without overwhelming him/her. Accompanying him/her through learning opportunities and participating in the continuous exchange in a never ending learning process. Demonstrating openness to change him/herself.

Focus oriented

The mentor must be skilled in helping the mentee to identify and pursue his/her goals. Maintaining focus on the purposes of the relationship will make meetings more productive. Remember that a mentoring relationship flows parallel to real life. While supporting the mentee in unexpected or occasional problems, the mentor must help him/her not to lose sight of the true goal. Rather, it will help him/her reformulate it if necessary.

Orientation to networking

The ability to build a network of relationships and help others to do so is essential. For the mentor him/herself, having a reference network will be useful when he/she will have to face unexplored problems and will be of support for the mentee and his/her contacts.

Good character

Needless to say, but we emphasize it. Patience, availability, positivity, humility are indispensable characteristics for a mentor. Remember that your main purpose is to support the mentee in his/her growth. Do not show off for your success!

Flexibility

The mentor is a helmsman who must adapt to the situation he/she faces. Depending on the mentee and circumstances, he/she must be a coach, counsellor, trainer, networker, guide, be challenging or welcoming, be proactive or indulge. And the mentor must be able to help the mentee deal with change.







5. Cooking as a teaching tool

Cooking can be an effective and enjoyable way to teach various skills to people with intellectual disabilities, including those related to STEM (Science, Technology, Engineering, and Mathematics). It's essential to tailor cooking activities to individual needs and abilities, making adjustments as necessary. Accessible kitchen tools and adaptive equipment can enhance the learning experience for individuals with different abilities.

Almost every aspect of learning can be incorporated in cooking activities from colours, textures, smelling, pre-science, developing vocabulary, visual awareness, and measurements. Learners constantly learn literacy in cooking activities because they are picking up on new words for foods that they are being introduced to and are cooking with. They learn how to follow directions and you can even teach geography by introducing foods from different areas or discussing where certain ingredients come from. Besides introducing learners to healthy eating habits and introducing good nutrition early on, they can start learning all sorts of things from academic skills to fine and gross motor skills by using plastic serrated knives to cut foods. They learn how to follow directions if you talk to them about a recipe and it's also great in incorporate things like pictographs or books into the cooking so that it takes the learning beyond the kitchen.

For some, cooking is a daily chore, social experience or an entertaining leisure activity. For others, cooking is a way to learn new things. Learning the process of cooking and preparing food to improve physical and mental well-being, promote learning and skills development, and improve social inclusion and community engagement. That is, the process of engaging individuals in cooking and meal preparation with the support of educators to achieve specific therapeutic goals, over a period of time with expected learning outcomes (what knowledge and skills are acquired by the learners) with elements of monitoring and evaluation. Teaching cooking encompasses the act of cooking and a variety of cooking-related activities, which can be to harvest fruits from your own cultivated garden, to buy groceries, to use utensils and kitchen appliances, and to plan and prepare meals. Cooking as a teaching tool uses the kitchen as a safe place to develop one's ability to socialize, make friends, and learn practical skills that will help them become more independent. Using culinary tasks, educators evaluate and design a range of individual activities for each individual to improve their competencies and work toward the specific goals they want to achieve.

(Metura, 2020)







In addition to learning a valuable life skill, cooking as a teaching tool also offers the following benefits: stress relief, enhances social skills, balance and coordination, sensory awareness, ability to plan and organize, attention and focus, develops self-esteem and a sense of self-realization. Cooking is an incredibly flexible medium that can transform lives and help everyone, regardless of age or disability. Cooking has many benefits as learners receive something tangible for their efforts. The advantage of the cooking process is also the fact that it results in delicious food, a good "reward" for the task, and a demonstration that your actions have resulted in something real. Preparing a meal also helps to provide a sense of power and action, something that you would not naturally be able to experience your own in everyday life outside the kitchen. This sense of achievement has been noted by psychologists, who claim that cooking acts therapeutically because it corresponds to a type of therapy known as "behavioural activation" which means finding meaning in the things you do, not just going through them.

Cooking also involves many soft skills, that can efficiently be improved and experimented in a cooking learning environment, such as:

- **Problem solving skills:** assembling and preparing ingredients involve problem-solving and organizational skills, aligning with engineering principles. Adapting recipes or using alternative ingredients may require creative problem-solving.
- **Multisensory Learning:** cooking engages multiple senses, providing a holistic learning experience that accommodates different learning styles. Tactile experiences, such as handling ingredients, can be particularly beneficial.
- Life Skills: cooking teaches essential life skills, such as following directions, time management, organization, and safety in the kitchen. These skills contribute to increased independence and confidence in daily activities.
- **Social Skills:** cooking in a group setting encourages teamwork and communication, promoting social interaction. Sharing meals with others fosters social connections and a sense of community.
- Adaptability: cooking allows for adaptability in terms of modifying recipes to accommodate dietary restrictions or preferences. Adapting cooking techniques or tools to individual needs encourages a personalized and inclusive approach.
- **Cognitive Development:** following recipes, remembering steps, and making decisions during cooking contribute to cognitive development. Engaging in cooking activities can stimulate memory, attention, and problem-solving skills.







Cooking can be a great group or a family activity. Cooking is a fantastic way for you to spend the afternoon with the family, teaching each other a life lesson or two at the same time. Teaching family members the basics of cooking is important because remember, they'll become more independent and be able to cook their own dinner. Cooking also gets you out of the house since you need to buy ingredients – going to the supermarket, visiting the farmers market. Cooking doesn't have to be a "follow step-by-step" activity. In fact, you don't even have to cook something straight out of a recipe book (or from a recipe website). After preparing and cooking food for some time, one gets used of it and learn a range of different cooking methods. It's at this point that one can start to explore cooking on their own and come up with own recipes and dishes. The sense of accomplishment you feel afterward can be a boost for your self-esteem.









6. Sustainability & Green practices

a) Seasonality of food

Seasonality of food refers to the concept that certain foods are naturally harvested or available during specific times of the year due to the local climate and growing conditions. This natural cycle influences the availability, freshness, and nutritional content of various fruits, vegetables, and other agricultural products. Understanding and embracing the seasonality of food has several important implications because it allows us, the consumers, to make informed choices that align with nature's cycles. It promotes a holistic approach to nutrition, supporting both personal health and the well-being of the environment and local communities. Choosing seasonal, locally sourced foods is a practical way to promote sustainability and contribute to a healthier, more resilient food system.

Seasonal foods are often harvested at their peak ripeness, which means they are more likely to have higher nutritional content. Therefore, eating a variety of seasonal foods throughout the year provides a diverse range of nutrients, supporting a balanced and nutrient-rich diet. Moreover, seasonal product has better flavour and taste because it is allowed to ripen

naturally on the plant before being harvested.

Embracing seasonality reduces the need for extensive transportation and storage, which helps lower the carbon footprint associated with food production and distribution.

It encourages the consumption of locally grown and sourced foods, supporting regional agriculture and reducing the environmental impact of long-distance transportation.

Supporting seasonal and locally grown foods helps sustain local farmers and promotes a more resilient local food system.

You can find more here:

<u>(Seasonal Food, 2024)</u> <u>(The Wheel of the Seasons, 2024)</u> <u>(When You Shop Use Your Head, 2024)</u> Therefore, it is important to know which vegetable and fruits are seasonal when deciding what to cook, paying attention to the fact that product availability in local supermarkets is not linked to seasonality but mainly with food habits, marketing, and other commercial choices. There is plenty of information about seasonality of food, find it on the web and use this important aspect when planning a cooking activity. Seasonal eating aligns with cultural and culinary traditions that have been shaped by the availability of certain foods at specific times of the year, so it encourages a connection to local food cultures and heritage. Last but not least, seasonal foods are often more abundant and, as a result, can be more affordable. (The Wheel of the Seasons, 2024)

(Seasonal Food, 2024)

When You Shop Use Your Head, 2024



Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



a1) The double pyramid connecting health, food and sustainability

The Double Pyramid is a concept that combines the traditional food pyramid with an environmental pyramid. It was developed by the Barilla Center for Food & Nutrition (BCFN) to visually represent the interconnection between our dietary choices and their environmental impact. The Double Pyramid serves as a tool to promote sustainable and healthy eating patterns. On one hand we find the traditional food pyramid, that illustrates the recommended distribution of food groups for a healthy diet. It typically places foods like fruits, vegetables, and whole grains at the base, indicating that they should form the bulk of our diet. As you move up the pyramid, food items like dairy, meat, and sweets are consumed in moderation. On the other hand, we have the environmental pyramid, positioned alongside the food pyramid, that represents the environmental impact associated with the production and consumption of different food groups. It highlights the resource intensity, greenhouse gas emissions, and other environmental factors linked to various food choices.

The key idea behind the Double Pyramid is that the two pyramids should align: since foods with a lower environmental impact, such as plant-based foods are positioned at the base of both pyramids, this is indicating their sustainability and health benefits. Conversely, foods with a higher environmental impact, such as certain meats and processed foods, are placed toward the top of both pyramids. By aligning the food and environmental pyramids, this model encourages people to make dietary choices that are not only beneficial for their health but also considerate of the environmental impact of food production. This approach promotes a shift toward more sustainable and environmentally friendly food consumption patterns.

(Fondazione Barilla, 2024)

You can find more here: Fondazione Barilla, 2024







The Double Pyramid serves as a visual tool for raising awareness about the interconnectedness of our food choices and the health of the planet. It emphasizes the importance of adopting a diet that is both nutritionally balanced and environmentally sustainable for the well-being of individuals and the planet as a whole.



Adapted by an image of Barilla Centre for Food and Nutrition Original image:

https://www.fondazionebarilla.com/en/100-food-facts/





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



b) Food waste and loss

As households generate more than half of the total food waste in the EU (53% or over 31 million tonnes) with 69% of food waste arising at household, food service and retail (Eurostat, 2022) and given global developments in this area of work, prevention of consumer food waste is a key area of focus. Food waste and loss are significant global issues that have environmental, economic, and social implications: it refers to the decrease in the quantity or quality of food along the food supply chain. This can occur during production, post-harvest handling, processing, storage, and transportation. Food waste occurs at the consumer or retail level when edible food is discarded; it is a very serious issue that involves environmental, economic and social impact and consequences.

Among the main ones, we can underline the greenhouse gas emissions linked to overproduction and waste management, land and water usage, which are wasted too when food is not consumed. Social implications are very important too, from food insecurity to general ethical concern because wasting food while others go hungry raises ethical questions about resource allocation and social responsibility.

Among the causes of food waste and loss there are some that are directly linked to our choices as consumers and therefore are in our control in terms of possible changes: in fact, consumer behaviour plays a significant role in contributing to or mitigating food waste.

There are some key aspects where we, as consumers, can make conscious choices to reduce food waste, and where we, as educators, must focus when planning a cooking lesson:

Meal Planning:

The fact of planning meals in advance allows purchase only what is needed. Involve your learners in creating a shopping list to avoid impulse purchases and overbuying.

Storage Practices:

It is important to store perishable items properly to extend their freshness; involve your learners in understanding the difference between "sell by," "use by," and "best by" dates to minimize premature discarding. Explore the different parts of the fridge to store all goods in the proper way and encourage your learners to preserve food correctly. Freeze surplus items, such as bread, fruits, and vegetables, before they spoil; experiment with your learners to label items with freezing dates and composition.

Understand Expiry Dates:

Learn about date labelling on food products and understand that many items are safe to consume beyond the labelled date. Exercise your senses (smell, sight, taste) to assess food freshness.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



Portion Control:

Be mindful of portion sizes to avoid cooking more than necessary and encourage your learners to save and store leftovers for future meals and different preparations.

Using Leftovers:

Get creative with leftovers to create new meals, encourage your learners in incorporating leftover ingredients into soups, stews, stir-fries, or casseroles.

Supporting Local Initiatives:

Buy locally produced foods to reduce the environmental impact of long transportation chains. Go with your learners to meet food producers and farmers in local farmer markets, visit them in the countryside if possible to raise awareness and support community-driven initiatives to combat food waste.

Learn about Composting:

Consider composting food scraps instead of throwing them in the trash, you could also build a small compost.

By adopting these practices, consumers can significantly contribute to reducing food waste. The collective impact of individual choices can lead to more sustainable and responsible food consumption patterns. Education and awareness campaigns can further empower consumers to make informed decisions about their food choices and contribute to a more efficient and sustainable food system.

European Commission, Good practices, Food Safety, 2024) (European Commission, Prevent food waste and save money, 2024)

(Zero waste Europe, 2024)







b1) Chemical and Physical methods of food preservation

You can introduce some physical and chemical principles when dealing with food preservation with your learner!

Air or Sun drying – freeze, pasteurisation – sterilisation are all physical preservation methods that you can use and analyse in order to introduce physical changes in the materia, such as from solid to gas or from liquid to solid.

The chemical methods involve marinating, salt or sugar curing, vinegar preserving; these techniques are traditional and less expensive, and include both natural and artificial substances.

(Morris, 2016)

c) Packaging and recycling

Did you know that about one third of the food produced globally ends up in the rubbish? And that every year in Italy, about 145 kg of food is wasted per person? Food waste is a real problem that does not only affect people's consumption habits, but also the way food is stored. In all of this, packaging, understood as the packaging that protects and preserves food, has played a very important role for some time now, but will make an increasing difference in the future. As a first step, it is important to identify when food waste occurs, in order to understand how to intervene to reduce it. The question then is: is food waste only wasted at home? In reality, food waste is also generated in other situations besides the home: think of restaurants, for example, but also retail and large-scale distribution. Food waste is therefore a problem that affects the entire supply chain and, in addition to constantly improving one's consumption and purchasing habits, packaging can provide strong support in improving food preservation.

It is important to keep in mind that when we talk about eco-sustainable materials we must consider not only the end of life of the product – i.e. where do I throw it? – but also its material composition and how much logistical impact (transport) is required to create that material, because this means CO_2 emissions into the environment. Precisely to emphasise the importance of this last aspect, for some years now we have been talking about the Carbon Footprint, i.e. the measure that expresses in CO_2 equivalent the total greenhouse gas emissions associated directly or indirectly with a product or service.

Thanks to this important measurement tool, combined with a 'holistic' or global approach, each of us can make choices that are truly eco-sustainable and feel an active part in protecting the environment.







Therefore, considering packaging and recycling when cooking is important for several reasons:

Enviromental Impact	Packaging materials contribute to environmental pollution, especially when they are single-use and not easily recyclable. Many packaging materials are derived from non-renewable resources, and their production contributes to deforestation, habitat destruction, and greenhouse gas emissions.
Waste Reduction	Choosing products with minimal or eco-friendly packaging helps reduce the amount of waste generated during food preparation and cooking. Cooking with a focus on waste reduction involves thoughtful planning and using ingredients with minimal or recyclable packaging.
Recycling Opportunities	Selecting products with recyclable packaging allows you to contribute to recycling efforts. Proper disposal and recycling of packaging materials help divert waste from landfills, conserving resources and reducing environmental impact.
Energy Consumption	The production, transportation, and disposal of packaging materials require energy. Using products with less packaging or opting for materials that are easily recyclable helps decrease the overall energy footprint associated with food packaging.
Sustainable Choices	Choosing products with eco-friendly packaging encourages food producers to adopt more sustainable practices. Supporting brands that prioritize sustainable packaging can drive positive changes in the industry.
Educational Opportunities	Considering packaging and recycling in cooking provides an opportunity to educate others, such as family members or guests, about the importance of making environmentally conscious choices and promote a circular economy.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



In summary, considering packaging and recycling when cooking is a responsible and environmentally conscious approach. It involves making mindful choices about the products you purchase, reducing waste, and actively participating in recycling efforts. By incorporating these considerations into your cooking habits, you contribute to a more sustainable and ecofriendly food system.





d) How to use Leftover for balanced recipes

Before you throw the stems of broccoli, the heart of cabbage or fennel, the leaves of cabbage, the green part of leeks, potato skins or other parts of the vegetables you are using for cooking, stop for a moment and ask yourself: how can I avoid throwing it away and how could I transform it into a recipe?

Most leftovers can be reused in creams, jams, pâté, purees, stir-fries or other basic preparations simply by adding a few transformation steps that could be steaming, chopping, mincing or other techniques. This step is important in one's daily life, but it is even more important when using the kitchen for educational purposes because through this practice we can promote awareness as well as reduce waste.

On the internet you can find many recipes in all languages for reusing waste, try researching with your pupils and discover new solutions every time for not throwing away practically anything from your fruit and vegetable supply.







7. Safety in the kitchen

In this chapter we will talk about Food safety and hygiene, also about food handling and good practices, risk of contamination, food storage, proper use of the fridge, expiration dates and reading labels. We will present accessible kitchen: setting up the space and recognising work tools; knowledge of appliances, adaptive space.

a) Kitchen safety

What is Kitchen Safety? It's knowing the environment and the tools you're dealing with, and thus keeping your kitchen accident-free as you cut, chop, slice, dice, mince, mix and perform other kitchen-related duties.

The kitchen is a bustling space where culinary creations come to life. However, amidst the aromatic symphony of spices and the sizzling sounds of the stove, it is essential to prioritize kitchen safety. From sharp knives to hot surfaces, the kitchen can harbour potential hazards that, if not managed appropriately, may lead to accidents. We'll explore the importance of kitchen safety and offer practical tips to create a secure culinary environment for everyone.

Understanding the potential hazards in the kitchen is the first step toward ensuring safety. Common risks include sharp objects like knives, hot surfaces such as stovetops and ovens, electrical appliances, and the potential for slips and falls. Identifying these hazards allows for proactive measures to mitigate the associated risks.

Maintaining an organized kitchen is essential for safety. Store knives and other sharp objects in designated blocks or magnetic strips to avoid accidental cuts. Keep frequently used utensils and pots within easy reach to prevent unnecessary stretching or reaching over hot surfaces. Adequate storage and organization minimize clutter and contribute to a safer cooking space.

Store strong cleaners, lye, furniture polish, dishwasher soap, and other dangerous products in a high cabinet, locked. Detergent packets or pods pose a special risk for learners, who may mistake them for other liquids. If you must store some items under the sink, use an automatically fastening child safety lock. Never transfer dangerous substances into containers that look as if they might hold food as this may tempt somebody to taste them.

Kitchen safety is closely tied to heat management and fire prevention. Be vigilant when using stovetops and ovens, never leaving them unattended while in operation. Keep flammable items, such as towels and pot holders, away from heat sources. In the event of a grease fire, smother it with a lid or use a fire extinguisher, avoiding water as it can exacerbate the flames.







Electrical appliances, while convenient, can pose risks if not used and maintained correctly. Ensure that cords are in good condition, and avoid overloading outlets. Unplug appliances when not in use and handle them with dry hands to reduce the risk of electric shocks. Regular maintenance, such as checking for frayed wires, contributes to the overall safety of kitchen electrical devices. Unplug appliances when not in use.

The kitchen floor is susceptible to spills, which can lead to slips and falls. Promptly clean up spills to prevent accidents, and consider using non-slip mats in areas prone to wetness, such as near sinks and dishwashers. Wearing appropriate footwear with good traction further reduces the risk of slipping.

In the culinary world, safety should be as essential as the ingredients in any recipe. By identifying common hazards, practicing proper storage and organization, handling knives and utensils with care, managing heat and fire risks, ensuring electrical appliance safety, and preventing slips and falls, we can create a kitchen that prioritizes the well-being of those who use it. Embracing a safety-first mindset in the kitchen not only enhances the cooking experience but also contributes to a healthier and more enjoyable home environment. Remember, a well-prepared meal is not only delicious but also the result of a safely executed culinary process.

(Kitchen Safety, 2022)

a1) HACCP

What is HACCP and why it is important when working in the kitchen?

The Hazard Analysis and Critical Control Point (HACCP) is a recognised way of making sure food safety hazard in food businesses and processes are made responsibly; it is a system introduced in EU in 1993 and it is a legal requirement in all EU countries. The Hazard analysis addresses three main types of risks in food production; biological hazard, when foods become infected by bacteria which could led to food poisoning, physical hazards, through foreign bodies such as metal or plastics, and chemical hazards such as potentially dangerous chemical like cleaning fluids or pesticides can contaminate food.





(Food and cooking safety, 2024)

(Kitchen Safety Rules, 2024)

Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731


b) Accessible kitchen

Accessible kitchen tools and adaptive kitchens are designed to accommodate individuals with disabilities, making cooking tasks more manageable and enjoyable in order to promote independence, safety, and comfort for individuals with various physical or cognitive challenges. Using high-contrast colours in kitchen tools, utensils, and dishware can assist individuals with visual impairments in distinguishing between items.

There are a variety of tools that make the physical movements for cooking easier and more accessible, but it is necessary to test tools before using them with our participants. Any cooking challenge can be made more accessible to those with disabilities with some creativity and research. If a recipe requires multitasking, consider setting a kitchen timer for each task. You can use a multi-event timer with different alarms and a whiteboard to keep track of which alarm is associated with each task. Remember to practice safe cooking techniques and to have fun!

Here are some examples of accessible kitchen tools and adaptive features:

Ergonomic Utensils: Utensils with ergonomic handles are designed to provide a comfortable grip and reduce strain on the hands and wrists. Adaptive utensils with built-up handles or those designed for one-handed use can be beneficial. Jar openers are helpful for those with limited hand strength or coordination Utensils are available with large or silicone handles and at different angles to promote ease of use. These specialized tools can be used hand-over-hand until the individual is comfortable with using the device independently. Many cooking supplies are available with non-slip surfaces, which prevent them from sliding around while you're cooking. For example, non-skid mats placed on countertops and tables prevent dishes and kitchen tools from sliding, providing stability during food preparation.

There are mixing bowls available with non-slip bottoms as well as cutting boards with non-slip edges to keep them from sliding. Another important tool can be the tong, a spring-loaded gadget that can assist those who struggle with bilateral coordination. It comes in a myriad of shapes, sizes, and materials, and it can be used to strengthen fine motor skills or to help flip pancakes over a hot griddle; some examples could be turning tongs, silicone locking tongs, and beginner training chopsticks. Grading pressure can also be improved using these tools, because to pick up a soft object involves assessing how much strength is needed to hold the object without breaking it.









Cutting Aids: Adaptive cutting boards with non-slip surfaces and built-in knife guards can enhance safety during food preparation. One-handed cutting devices or electric knives may be useful for individuals with limited dexterity. There are some alternatives to normal metal knives, such as plastic lettuce knives, which work great for most recipes involving cutting. They have no sharp blade, cut most fruits and veggies, and are available in many styles. Be aware that cutting hard vegetables, such as carrots, can be difficult. It is also possible to find plastic pizza cutters which can be used to cut a variety of foods, such as sandwiches.

Reacher Grabbers: Reacher grabbers or tongs with extended handles help individuals with mobility challenges reach items on high shelves or in cabinets without the need for excessive bending or stretching.

Easier-to-Understand Tools: Some tools can assist with the cognitive aspects involved in cooking. Mathematical tasks like measuring can be difficult, but are made easier by big labels or color-coded measuring cups.

For example, nesting prep bowls have cup measures in the bottom, can be differentiated by colour, and are useful in sorting out materials in preparation for beginning a recipe.

Accessible Appliances: Kitchen appliances with large, easy-to-read controls and tactile markings are accessible to individuals with visual impairments. Appliances with programmable settings and audible timers can be helpful for those with cognitive challenges.

Voice-Activated Devices: Smart kitchen devices equipped with voice-activated controls or virtual assistants can assist individuals with limited hand mobility or dexterity.

Adaptive Seating: Adjustable-height countertops or work surfaces allow individuals to use wheelchairs or seating devices comfortably while cooking.

Task Lighting: Adequate and adjustable lighting in the kitchen enhances visibility for individuals with visual impairments.

These adaptations and tools are just a few examples of the ways in which kitchens can be made more accessible. Customizing the kitchen environment based on individual needs and preferences is crucial for fostering independence and inclusivity for individuals with disabilities.

(Adaptive Cooking Tools, 2024)

(Kitchen Skills, 2024)

(Adapting your home: the kitchen, 2024)







8. STEM learning and education

STEM, standing for Science, Engineering, Technology and Mathematics represents the group of subjects that fall within these four areas of study. In the increasingly technical society we are living in, STEM is part of our everyday lives, which are constantly being changed by innovations in these fields. In order to keep pace with changes and face the increasing challenges, people of all ages need to be well-informed in STEM subjects and have corresponding STEM competences.

As written in the UNESCO report (UNESCO, 2019) STEM competence refers to an individual's ability to apply STEM knowledge, skills and attitude appropriately in their everyday life, workplace or educational context. The role of STEM learning and education is reported as being crucial and its acknowledged objective is to develop well-informed and highly competent citizens who will be able not only to meet future labour market demands, but also to ensure for them a sustainable and quality life.

Since 1956, knowledge, skills and attitudes, connected to the cognitive, psychomotor and affective domain were identified by Benjamin S. Bloom (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956) as the three key areas to analyse the nature of learning and the objectives of education. Taking into consideration Bloom's taxonomy and focusing on STEM education as a means to develop STEM competence, knowledge refers to the understanding and awareness of facts, information, and concepts related to a specific topic and involves the acquisition of information through experience. It includes things you know and usually can be found written in textbooks. Knowledge is something that you have conscious access to and can tell someone about. The fact that the earth rotates on its axis and revolves around the sun creating day and night and seasonal changes, or the information that cooking in a pressure cooker reduces cooking time are examples of STEM knowledge.

Skills are the practical abilities and expertise that individuals possess in performing specific tasks or activities. Three main categories of skills have been identified as being required for success in 21st century society: Learning Skills which are required for acquiring knowledge, Literacy Skills which aid in gaining knowledge through reading, media, and digital resources and Life Skills which are necessary for successfully navigating everyday life. Skills are developed through practice, training, and hands-on experience. They are things you do or do in a particular way and most of the time you don't even have conscious access to, like weighing with a scale, or choosing which is the best tool to perform a specific task. However, almost always, you use knowledge when you perform a skill, and this knowledge allows you to describe what you can do.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



Attitudes refers to a person's mindset, beliefs, and opinions towards a particular subject or situation. Specifies what they actually tend to do and encompass their emotional and behavioural responses. For instance, most of the people believe that science is only for scientists and is hard to understand and this belief makes them unwilling to get informed about STEM topics (see also Chapter 9 of this document).

Trying to define STEM education is not easy, nor simple and it would be inaccurate to say that is merely instruction in Science, Engineering, Technology and Mathematics. Referring to UNESCO's report (UNESCO, 2019) STEM education refers to the integration of the four subjects into a cohesive, interdisciplinary learning approach, which includes real-world applications and teaching methods. It may take place in formal organizations like schools and universities, in non-formal settings such as science museums and in informal environments inside the family or community. STEM education focuses more on the practical aspect of learning, aiming mainly to develop knowledge, skills and attitudes that are necessary in the rapidly-developing world we are living in. STEM education transforms the traditional teachercentered courses into ones where problem solving and discovering-exploratory learning, through collaboration and teamwork, play the predominant role.

a) Cooking as a means in STEM education for adult persons with ID

a1) The science behind the cooking

Cooking is significant to everyone regardless of age, gender or cultural factors, and is often invested with strong positive feelings. As an everyday activity happening at home it motivates families to get involved, to contribute actively with their previous knowledge and experience and to work together to reach a specific goal.

At the same time the process of cooking and preparing meals could also be considered as an applied science. It is strongly rooted in science (physics, chemistry, biology) with mathematics, technology and engineering also involved, either when we ourselves cook everyday dishes in our kitchens, or when chefs prepare meals and develop unusual new dishes in restaurants.

While foods are prepared and cooked, ingredients are going through physical, chemical and biological changes. Certain elements are necessary in order for a recipe to turn out in a tasty food and a myriad of different processes take place to transform the ingredients and lead to new textures and flavors. Kitchen can be easily considered as a science lab in which the structure of matter can be studied, a lot of scientific phenomena can be observed and several scientific concepts can be visualized. (Mata, 2013)





The whole process of cooking involves several physical changes and phase transformations. Heat transfer, which takes place through conduction, convection, radiation, or a combination of them, is one of the most important and common processes in cooking, which leads to ingredients' phase transformations. Frying, boiling, and grilling are related to rate of heat transfer and during cooking the food dissolves, stretches, breaks, and flows. Heat changes the nature of how food molecules function and interact with each other, while a lot of chemical reactions between different components are taking place forming new compounds. Amino acids which react with sugars in high temperatures make meat tastier and egg's white turns solid as heat breaks down its enzymes. As chicken marinated in lemon juice, acid breaks down the proteins making it tender.

Microorganisms play a significant role in preparing food too. Combining the right microorganisms with specific temperature, time, techniques and procedures, changes in the biochemical profile of foodstuffs are happening, which lead to changes in nutritional content, flavour, aroma, texture, and digestibility. The biological phenomenon of fermentation for instance is an important element of food preparation in making alcohol, sauces, and bread. Also, microbiology is vital to the preservation, processing, and production of food as well as to food safety.

Apart from science, cooking also includes a lot of mathematics, as measurements and calculations are used all the time. Ingredients must be measured and scaled accurately, food production quantities should be calculated, and recipes have to be increased or decreased to scale based on demand. Technology also plays a significant role in cooking. All these tools and devices which are available in the kitchen make cooking easier, saving time and money.

Focusing more on the procedure of cooking, the whole process can be perceived as a hypothesis-driven process, just like science (Rowat et al, 2014). **Inside the kitchen, while we prepare and cook our meals, we can observe almost all the steps of the scientific methodology: we ask questions, make a hypothesis, test the hypothesis with an experiment, evaluate the result and make future decisions based on this result. Let's see how: Imagine you just enjoyed a meal and you decided to cook it by yourself. First you ask yourself questions about the ingredients that may have been used and how the food was baked or cooked. Based on your previous experience and your observations (looking, smelling, tasting) you make a prediction (hypothesis) and test it by starting to cook (experimentation). When the food (result) is ready, seeing, smelling and tasting it tells you whether your initial hypothesis was true/correct or false. If it is correct, you write down the recipe and follow it next time you want to cook the same meal. Maybe you do share it with a friend too! If it's wrong, you may create a new hypothesis to test it, so the cooking starts again...**







b) Key competences and basic skills in the field of STEM that can be improved with cooking activities

According to the European Commission report (European Commission, 2019) everyone has the right to quality and inclusive education, training and lifelong learning that develops basic skills and key competences, which are needed for personal fulfilment and development, employability, social inclusion and active citizenship. The eight key competences for lifelong learning defined by this report are:



In the context of diversity, equity and inclusion (DEI) persons with intellectual disabilities (ID) should definitely be included in STEM learning and education, which gives them the opportunity to develop and practice a lot of basic skills and key competences.







According to Taber-Doughty 's review article (Taber-Doughty, 2015) numerous studies confirm that even students with severe disabilities are capable of learning complex and abstract skills when systematic instruction and appropriate support are provided. Research findings report the success of these students as they learn to use science inquiry and mathematics skills for solving problems. However, the greatest challenge she identifies is to find appropriate, creative strategies/approaches and prepare the teachers to implement them.

Taking into consideration European Commission's recommendations (European Commission, 2019) that "Competence development is best supported when taking place in a variety of learning environments and through the collaboration among education, training and nonformal learning stakeholders in local communities and employers", the project Science of Cooking suggests an educative approach in STEM for adult persons with ID using the appealing and fun procedure of cooking and preparing meals in a kitchen.

Using food and cooking as a means for STEM education has a great potential (Barham, et al., 2010), (Mata, 2013) mainly because it is an everyday activity which is relevant and meaningful to all people (Grosser, 1984). In terms of key competences, involving adult persons with ID in well-designed cooking activities gives them the great opportunity to develop STEM competence. They can gain scientific knowledge about basic STEM concepts and phenomena, such as heat and chemical reactions and practice STEM related skills, such as observation, problem solving, measurements and math calculations (Rowat et al, 2014). Furthermore, they practice their literacy and reading skills through a creative and fun activity, which gives them the chance to develop personal, social and learning to learn competences as well.

Introducing STEM topics through cooking may also have an impact in changing people's notions and attitudes around STEM making a positive contribution to a better understanding of the role of science and scientists in everyday life (Mata, 2013). Through cooking people can find themselves engaged in science in a way that at the end makes them realize that science is everywhere around us, is not only for some people but for all, is not as difficult as they believed, it has a lot to do with real life and can help to understand real life situations. Learning about STEM subjects while preparing meals, rather than being boring, can be really exciting and fun. It reveals that learning itself is not all about gathering knowledge by reading textbooks but it includes also active participation and physical activity.

Especially for people with disabilities, what counts as meaningful and relevant is anything that will allow them to function with greater autonomy within and across their community, enhance their ability to develop relationships with others, improve their opportunities for further learning, and lead to employment opportunities.







Cooking programs that incorporate STEM concepts can be particularly effective in promoting inclusive education and skill development. If we consider STEM, we can underline the following topics:

Mathematics

- Measuring ingredients requires numerical skills, providing practical applications for mathematics.
- Calculating proportions when adjusting recipe quantities reinforces mathematical concepts.

Science

- Cooking involves various scientific principles, such as understanding chemical reactions during baking or the effects of heat on different ingredients.
- Experimenting with ingredients and observing changes during cooking can enhance scientific knowledge.

Technology

- Utilizing kitchen appliances, such as blenders, mixers, or ovens, introduces individuals to technology in a practical context.
- Understanding and operating kitchen gadgets can improve technological skills.

b1) Mathematical competences

Mathematics plays an important role in the culinary arts. There are helpful tools, such as measuring cups, measuring spoons and scales, to aid in food preparation. However, some background in measurement, fractions and geometry is necessary when cooking and baking. Chefs need to be able to measure and weigh ingredients, time recipes, and adjust and measure cooking temperatures. Furthermore, when creating recipes for special diets, it's important to have a background in the science and mathematics of nutrition.







Measuring:

Measurement is an important math skill that significantly impacts the ability to cook properly. Tools like a glass measuring cup with a spout for liquids and measuring cups for dry ingredients are needed in every kitchen. Measuring spoons for spices and a scale to measure the weights of different foods are also necessary. Even with the use of all measurement kitchen tools, it is required that cooks and bakers understand the metric system and standard system of measurement so that they can apply those skills to following a recipe. Measuring also helps you have the perfect portion. So, you won't have too much of that and less of this.

(Metura, 2020)

Temperature and Time:

Telling time and adjusting temperature are important math skills that factor into the culinary arts. Recipes require different amounts of time, so cooks need to set a timer and monitor food accordingly. Furthermore, temperature adjustment is also very important. When cooking meat in an oven, use a meat thermometer to determine whether your dish is completely cooked. For example, chicken should be cooked to 180 degrees to ensure that bacteria are killed. When cooking at different altitudes, temperatures may need to be increased or decreased in your oven to bake successfully. In addition, altitude effects the boiling point for range-top cooking.

Fractions, Division and Geometry:

An understanding of fractions is crucial to cooking. Aside from measuring in recipes, the use of fractions also impact serving size. For example, if a recipe claims to serve eight people, but you are only serving four, the cook must be able to divide the entire recipe in half. Typically the cook will be required to divide whole numbers as well as fractions. Geometry is used in the presentation of food and baking. If a cook is creating a fancy layer cake, the use of rectangles, squares and circles may be necessary. When arranging food onto a plate, cooks should use different shapes to make foods aesthetically pleasing.









Examples off food related in geometry and angles: Straight: Exactly 180 degree – spaghetti Acute: Less then 90 degree, more than 0 degree – tortilla chips, piece of cake Right: Exactly 90 degrees – perfect square, pizza sliced ¼



Nutritional Data: many cooks must take into consideration health and balanced diet when cooking. As a result, knowledge of calories, fat, sugar and sodium are important for the everyday cook. Using the nutritional information on fresh and packaged foods will enable a cook to provide guests or family members with balanced meals that use a variety of food groups. In addition, calorie, sodium and fat needs vary greatly from person to person. Knowing the dietary requirements of those you are cooking for allows you to create an appropriate menu using nutritional calculations.

Cooking is also related to budgeting: for example you make 200 € per week and you need to buy food and pay other bills. You need to organize how much you are going to spend on food, transportation, electricity bill, etc.



b2) Science competences

Science competences are often needed when cooking, though we tend to not see them as science skills, when we are observing, when water will finally boil. Science process skills are skills that are required in the process of finding solutions to a problem or making decisions in a systematic manner. Science skills include: observing, measuring, sorting/classifying, inferring, predicting, experimenting, communicating, interpreting data.







The use of heat, cold, and cutting changes the composition of foods. Even simply slicing an apple sets off chemical reactions that change the color of the apple's flesh. If you heat up sugar to turn it into syrup, you're using a chemical reaction. If you add corn syrup to sugar because the corn syrup provides molecules that help form the final product of caramel, you're using a chemical reaction. Once you start learning how these specific processes work, you can use them to your advantage, creating effects in food that make plain dishes look fantastic. If you know that sugar browns in heat, you know that adding a sprinkle of sugar to the top of a product will give the final cooked product a nice caramelized look. If you change a cooking method, you will be able to tell if the final product is fine because you'll know which reactions no longer happened. For example, cookies baked in an oven turn golden or brown as the sugar in the dough caramelizes. But if you're expecting that, you'll know that the looks are not a problem as long as the cookies show other signs of being done. You won't keep trying to brown the cookies because you're aware that the chemical reactions will be different. Knowing chemistry in food is also helpful when creating copycat dishes for people with special dietary requirements. If you're cooking for someone who can't have eggs, you'll know that you need to find a substitute binder for the recipe, for example. (Metura, 2020)

Chemistry and food also comes into play when you're trying to verify old cooking legends and advice. For example, if you know how pasta absorbs water, you'll know that you don't have to use tons of water to cook a little pasta. That's a very simple example, but it shows you how you can cut experimentation and cooking time if you already know the basic chemical reactions behind what's happening when food cooks.

(ECPI University, 2020)







c) STEM topics to be addressed through cooking

The following paragraphs address the main phenomena and principles of chemistry, physics, biology and mathematics that apply when cooking and preparing meals in a kitchen. A first level of didactic transformation of the scientific content was carried out to make it comprehensible to a non-expert audience. This didactic transformation concerns mainly the concepts and phenomena chosen to be presented, the depth and breadth of information provided and the language and terminology used.

Starting from this content, as a next step we will identify and prioritize the STEM topics (concepts, phenomena, procedures etc.) we are going to work on and explore further with our target group. For each STEM topic, engaging activities, relevant experiments and demonstrations, visual material and games will be proposed as didactical means and tools to achieve better understanding and facilitate learning. The tools and and didactic material will be developed in the next phase of SoC project.

In the final step, all teaching means and tools will be linked and integrated into selected cooking recipes, utilizing the ingredients of the recipes, the tools and devices that will be used to carry out the recipes, the preparations that will be made and generally the whole cooking process. The results will be presented in STEM learning cookbook made in the project Science of cooking.

c1) Talking about Physical Quantities and their Measurements

Physical quantities are properties of objects that we can measure using instruments or even our senses. They are essential as they help us to describe and understand the world around us. Examples of physical quantities are mass, length, time, temperature, electric current, light intensity, force, velocity, density, and many others.

Measurement is a fundamental process and a universal tool, serving as a means of comparing known quantities with unknown ones. Whether we are comparing the mass of the Sun to that of the Earth, estimating the temperature of a star based on its color, or calculating the temperature of the coals on the barbecue or even the cooking time of a meal in the oven, the principles of measurements remain constant, providing a framework for understanding and interaction.







Units are the values of reference we use to measure these quantities accurately. By comparing an object's physical quantity to a standard unit, we can determine its exact value. There are three main metric systems which are somewhat used on an international basis (CGS, FPS, MKS). However, in order to foster collaboration within the scientific community, it was deemed essential to establish a standardized unit system. The International System of Units (SI) was thus developed, where every physical quantity (fundamental or derived) is assigned a specific unit eg.: m (meter) for length, kg (kilograms) for mass, s (second) for time, K (Kelvin) for temperature, ml (milliliter) for volume. Without standardized units, it would be extremely difficult for scientists to express and compare measured values in a meaningful way.

In the kitchen, certain physical quantities such as mass, volume, temperature and time are of particular importance, forming the basis of cooking and meal preparation. Although the units and the instruments that are used to measure these quantities are not always the ones used by the scientists, their measurements are crucial to cooking as they guide recipes, ensure consistency and ultimately, affect the taste, texture and overall success of culinary creations.

Mass

Mass refers to the quantity of matter an object possesses. Mass can manifest in various densities and states – solid, liquid, or gas. Solids maintain standardized shapes and volumes, liquids possess consistent volumes but variable shapes, and gasses are characterized by their ability to expand or contract. In everyday contexts, such as the kitchen, mass is often measured using weight, with common units including grams (gr) and kilograms (kg).

Volume

Volume represents the space occupied by an object and can be measured in cubic meters, liters, cubic feet (in the US), or gallons. In kitchen settings, volume measurements may include cups (approximately 250 ml), teaspoons (5 ml) and tablespoons (15 ml). Notably, volume is influenced by temperature due to thermal expansion — when substances heat up, they expand, altering their volume.

Temperature

Temperature denotes the degree of hotness or coldness of a substance, intimately tied to the molecular motion within it and its current state. In the kitchen, temperature assessment extends beyond traditional thermometers; for instance, the readiness of a pan can be gauged by observing the behavior of a droplet of water. Common temperature benchmarks include water's boiling point (approximately 100 degrees Celsius, though it can vary with altitude) and freezing point (0 degrees Celsius). Observations like chocolate bars melting or water boiling offer practical indicators of temperature.

Time

Time serves as a metric for tracking the progression of events or phenomena. In the absence of change or evolution, time becomes immeasurable, illustrating the symbiotic relationship between time and processes. Consider a frozen meal thawing — its transformation highlights the interconnectedness of time and temperature, as chemical and biological reactions are often temperature-dependent. Consequently, alterations in temperature can significantly impact the pace of reactions and, by extension, the passage of time.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



c2) Talking about the State of Matter and Phase Transformations

At its core, matter is composed of tiny building blocks called atoms. Imagine atoms as the Lego bricks of the universe, combining in various ways to form everything we see around us. Within an atom, there are even smaller particles: protons, neutrons, and electrons. Protons and neutrons cluster together in the nucleus at the center of the atom, while electrons orbit around the nucleus in regions called electron shells. The arrangement of these particles determines the properties of different elements.

Atoms, like the individual spices in a recipe, come together to form molecules, creating the foundation for everything we see and touch. Some molecules band together in long chains, forming polymers (macromolecules), much like interlocking pieces in a complex puzzle. These polymers, whether they're the fibers in your clothes, plastic in your phone or proteins in your food showcase the incredible diversity of matter, each with its own unique characteristics and applications.

In physics and chemistry, a phase refers to a physically distinctive form of matter that shares certain properties, such as density, chemical composition, and physical state. Common phases of matter include solid, liquid, and gas. Each phase has distinct characteristics that distinguish it from the others.

Solids	Think about a table, a book, or even a rock. These are all examples of solids. Solids have a fixed shape and volume, which means they keep their form no matter how you move or handle them. The particles in a solid are tightly packed together and vibrate in place. This is why solids feel hard and stable.
Liquids	Imagine pouring water into a glass. Unlike solids, liquids don't have a fixed shape, but they do have a fixed volume. This means they take the shape of whatever container they're in, but they still have the same amount of matter. The particles in a liquid are still close together, but they can move past each other more freely compared to solids. This is why liquids flow and can be poured.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731 **Gases** Think about the air around you or the steam rising from a hot cup of tea. These are examples of gases. Gases have neither a fixed shape nor a fixed volume. They expand to fill the space available to them. The particles in a gas are spread out and move freely in all directions. This is why gases are invisible and can fill any container, no matter its size or shape.

Cooking can be considered as a process of multiple phase transformations. Generally, six phase transformations are observed for the solid, liquid and gas phases: Melting and Freezing, Vaporization and Condensation, Deposition and Sublimation. The first four of them can be easily noticed macroscopically while cooking and preparing meals in a home kitchen.

Melting	Melting is a transformation where a solid substance transitions into a liquid state under the influence of heat. This process occurs because as heat energy is absorbed, the particles within the solid gain kinetic energy, causing them to vibrate more vigorously and weaken the bonds holding them together. Melting exemplifies the dynamic nature of matter, where transitions between states can be as fluid as the substances themselves. Picture a cube of ice. As we add heat, the ice absorbs energy, causing its particles to gain kinetic energy and vibrate faster. Eventually, the bonds holding the ice molecules together weaken, and the ice melts into water — a liquid. In the same way a scoop of ice cream left under the warm sun begins to soften and eventually turns into a creamy pool and a piece of butter in a hot pan turns into ghee.
Freezing	Freezing is a process where a liquid substance turns into a solid when it loses heat energy. When a liquid cools down enough, its molecules slow down and come closer together, forming a rigid structure. As they do, they lock into place, creating the solid shape we recognize as ice. Freezing is like pressing pause on the movement of molecules, trapping them in a fixed arrangement. Think about pouring water into an ice cube tray and leaving it in the freezer – eventually, the liquid water transforms into solid ice. Or imagine making homemade ice cream. After mixing your ingredients and flavorings, you pour the mixture into an ice cream maker. By surrounding the mixture with a cold environment, typically achieved by adding ice and salt, you lower its temperature below its freezing point. As a result, the liquid mixture solidifies into a creamy treat — a solid.



Vaporization is a process wherein a liquid substance transforms into a gaseous state, typically through the application of heat. This phenomenon occurs because as heat energy is introduced, the molecules within the liquid gain kinetic energy, causing them to move more rapidly and break free from the cohesive forces holding them together. Eventually, these molecules acquire enough energy to overcome the intermolecular attractions entirely, escaping the liquid surface and entering the surrounding space as vapor or steam. Imagine you're boiling pasta. As you heat the water on the stove, it reaches its boiling point. At this temperature, the water molecules gain enough energy to break free from the liquid phase and escape into the air as steam – a gas.

Condensation is a process where a gas transforms into a liquid when it loses heat energy. When warm air cools down, its molecules slow down too, coming closer together. As they do, they can't hold as much water vapor, so the excess vapor turns into tiny droplets of liquid, sticking to nearby surfaces. Think about a cold can of soda on a hot summer day – tiny water droplets form on its surface and what happens when you turn off the stove and let the steam cool down? As the steam loses heat energy to the surroundings, its molecules slow down and come closer together. Eventually, they condense back into water droplets – a liquid.

Deposition is a process in which a substance transitions directly from a gaseous state to a solid state, bypassing the liquid phase entirely. This unique transformation occurs when gas molecules lose energy, often due to a decrease in temperature, causing them to slow down and come into close contact with a surface. Upon contact, these gas molecules undergo a change in state, transitioning directly into solid form without passing through the intermediary liquid phase. This remarkable process is responsible for the formation of snowflakes, frost, and even the intricate patterns seen in some geological formations, such as stalactites and stalagmites. While cooking, deposition can be observed in windowpanes on a kitchen when moist air comes in contact with a freezing cold window pane.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



c3) Talking about Heat and Heat Transfer

There are many different ways and methods to cook food. You can boil your food in a pot, fry it in a pan, bake it in the oven or grill it. At all these methods a lot of different things are happening. But the one most important thing that is happening for sure is that heat is being transferred by the heating source to the food. Heat rises up the temperature of the raw materials destroying potentially harmful bacteria and other microorganisms and transforming them to safe, easier to digest and tasty meals.

How much energy will be needed for a food to be cooked depends on the type of the raw material itself, its amount and its initial temperature.

In a practical notion, when cooking mixed vegetables in the same pan (same heat conditions), in an attempt to empirically balance their final texture in the final dish, we cut vegetables which are cooked more easily/quickly (e.g. broccoli) thicker than those that are cooked slower (e.g. potatoes or carrots).

Cooking utensils can be made from copper, stainless steel, aluminum or earthen pots. The material of the utensils can decide the time of cooking and also alter the taste of the food. This is happening because different materials have different ability to transfer heat. This ability is known as thermal conductivity. The higher the thermal conductivity of a material, the higher its ability to transfer heat. For example, frying an egg in a pan made of stainless steel needs a lot more time than using an aluminum pot just because the thermal conductivity of aluminum is almost 15 times higher than stainless steel.

In nature there are three ways that heat can be transferred: by conduction, by convection and by radiation. All of these three are met in the kitchen during cooking when you use cooking appliances and utensils. They have their own unique characteristics but there is some crossover between them.

• **Conduction**: direct contact with a heat source, such as in a cooking pan that touches an active element.







It is the transfer of heat through physical contact and it's the most common type of heat transfer. This transfer occurs at the molecular level — from one body to another — when heat energy is absorbed by a surface and causes the molecules of that surface to move more quickly. The molecules bump into their neighbors and transfer the energy to them, a process which continues as long as heat is still being added.

During cooking the burners on stoves conduct heat energy to the bottom of a pan sitting on top of it. When our raw steak touches the hot pan, heat passes through conduct from the pan to the steak rising up its surface temperature. Conduction is also responsible for moving heat from the outside of the meat to the inside transforming its structure.

Conduction is the slowest method of heat transfer, but the direct contact between the cooking surface and the item to be heated allows food to be cooked from the outside in.

• **Convection**: through some liquid or air, when boiling in water or frying in oil, or when baking in a stove.

Convection combines conduction heat transfer and circulation to force molecules to move from warmer areas to cooler ones. As the molecules closest to the heat source become warm, they rise and are replaced by cooler molecules.

There are two types of convection that are based on the movement of the heated molecules:

Natural Convection

It occurs when molecules at the bottom of a cooking vessel rise and warm while cooler and heavier molecules sink. This creates a circulating current that evenly distributes heat throughout the substance being prepared. For example, when a pot of water is placed on the stove to boil, conduction heat warms up the pot, which then heats the water molecules inside. As these molecules heat, convection causes them to move away from the interior of the pot as they are replaced by cooler continuous molecules. This current creates convection heat transfer within the water.

Mechanical Convection

It occurs when outside forces circulate heat, which shortens cooking times and cooks food more evenly. Examples of this include stirring liquid in a pot or when a convection oven uses a fan and exhaust system to blow hot air over and around the food before venting it back out.





• **Radiation**: via electromagnetic waves, such in grill or microwave.

In cooking, radiation is the process where heat and light waves strike and penetrate the food. There are two main radiant heat cooking methods: infrared and microwave radiation.

Infrared radiation utilizes an electric or ceramic heating element that gives off electromagnetic energy waves. These waves travel in any direction at the speed of light to quickly heat food, and are mainly absorbed at the surface of whatever you're preparing. Examples of things that create infrared radiation are glowing coals in a fire, toaster ovens, and broilers.

Microwave radiation utilizes short, high-frequency waves that penetrate food. These waves set in motion the water molecules inside the food and they transfer their pulse (thermal energy) to the rest of the molecular structure.

Microwave heat transfer usually cooks food faster than infrared radiation, as it is able to penetrate foods several inches deep. If you're heating a solid substance, this heat energy is transferred throughout the food through conduction, while liquids do so through convection. In the charcoal grill, we have a mixed situation. The heat comes both by conduction from the metal grill touching our food, and by convection from the heated air between the coals and the food, but mainly by infrared radiation from coals.

There are four main cooking methods involving heat transfer:

1. Boiling

Boiling is perhaps the simplest of all kitchen techniques and refers to heating a food in boiling water. For most vegetables the boiling temperature is close to 100 °C, which is the boiling point of water (under standard pressure at sea level).

3. Frying and Deep Frying

In frying a much higher temperature is used than when cooking in water. Food is fried when it is placed with a little fat or oil in a frying pan (shallow frying) or immersed in oil or fat (deep frying) at a sufficiently high temperature. In deep frying the surface temperature of food is well above the boiling point of water, so rapid boiling occurs.

2. Steaming

In the steaming process the food (such as vegetables, fish, or bread dough) is in contact with steam above boiling water and not immersed in water. Heat is transferred to the food as the gaseous water condenses at the food surface and releases its latent heat. In steaming the surface temperature is 100 °C due to the equilibrium between the two states of water.

4. Baking

In a baking oven the air temperature is kept fixed in the range 150–250 °C by a thermostat system. Air circulates the oven due to convection or forced circulation. In baking the water at the food surface is evaporating and the food is dehydrated.





c4) Talking about chemical compounds and chemical reactions

Cooking is the process of denaturing food with changes at the molecular level, in order to make it safe, healthy, nutritious and pleasant for the human body or preserved for later consumption. Once we have ingredients in the kitchen and start to cut, mix, and cook them, a vast range of chemical reactions come into play, destroying some and creating new flavor compounds.

A chemical reaction is the procedure by which molecules break their existing chemical bonds and the make new bonds to form different molecules. The starting atoms and molecules (the reactants) react with one another to rearrange into more stable atoms and molecules (the products). For example, when a slice of apple or avocado turns dark while open to the air, that is due to a chemical reaction. When baking biscuits in the oven, the baking powder reacts to release carbon dioxide bubbles which causes biscuits to rise. When a steak turns brown on the grill, that is caused by a combination of many chemical reactions (Maillard reactions).

A chemical reaction is written as an equation with the formulas of the reactants on the left and the formulas of the products on the right, and with an arrow showing the direction of the reaction. For example, the reaction of baking soda with vinegar to give sodium acetate, water and carbon dioxide is written as:



In this example vinegar is an acid and baking soda is a base. Acids, bases, and salts are the main chemical compounds that exist in our surroundings and are found in various substances including our food. Acids and bases are the foundation of chemical reactions in food preparation and cooking.

An **acid** is defined as a substance whose water solution tastes sour, turns blue litmus red (litmus is a kind of paper used to tell whether a solution is an acid or a base) and neutralizes bases. Acids can be found naturally in many foods and beverages. Vinegar, lemon juice, or wine, are very common ingredients in a marinade since they have been found to improve tenderness and juiciness and increase the weight of the product due to retention of water. Acids also prevent enzymatic browning in fruits and vegetables.

A substance is called **base** if its aqueous solution tastes bitter, turns red litmus blue or neutralizes acids. Usually they are soapy to touch and their aqueous solutions conduct electricity.



Salt is a neutral substance whose aqueous solution does not affect litmus. In nature, the bulk of the salts is crystalline. Salt is a common chemical additive used to enhance taste and preserve food.

In order to define a substance or a food as acidic, neutral or basic (alkaline), pH scale is used. pH scale of 1–14 gives the strength of any solution/substance/food. A value of less than seven indicates an acid, and a value of more than seven indicates what is called a base (or alkaline) solution.

c5) Talking about biomolecules and nutrients

Nutrients are the compounds in food that provide us with energy that facilitates repair and growth and helps to carry out different life processes. They are composed of elements such as carbon, hydrogen, oxygen, nitrogen, and phosphorus. The major classes of nutrients are proteins, carbohydrates and fats, which are grouped as macronutrients, and minerals and vitamins which are grouped as micronutrients.

• Proteins

Proteins are the most common macromolecules. They are formed from 20 different amino acids, which are linked together by peptide bonds, creating peptide chains. They are structural components of cells and organisms which control several biological functions. From a nutritional point of view, proteins belong to the macronutrients that provide energy to the body mainly in extreme situations, such as starvation. Gluten is an herbal protein found in wheat, rye and barley. Casein is an animal protein found in meat as well as in cow, goat and sheep milks.

• Carbohydrates

Carbohydrates are organic compounds (aldehydes or ketones), which contain multiple hydroxyl groups. They make up the largest percentage of organic matter on earth and are the main sources of energy for human beings. There are three main categories of carbohydrates, according to the number of simple sugars they contain in their molecule:

- monosaccharides or sugars (one sugar) like glucose, fructose and galactose.
- oligosaccharides (2–10 sugars) like lactose found in milk and milk products.

- polysaccharides (>10 sugars) like starch and glycogen. Both function as energy storage molecules. However, glycogen is produced, stored, and used as an energy reserve by animals, whereas starches are produced, stored and used as an energy reserve by plants.

Carbohydrates are found in a wide array of foods such as in bread, beans, milk, popcorn, potatoes, cookies, spaghetti and soft drinks.







• Fats or lipids

Fats or lipids are a heterogeneous group of compounds (any ester of fatty acids or a mixture of such compounds). They are the main components of vegetable oils and of fatty tissue in animals. Fats are the most important form of energy storage.

The three main types of fats for humans are triglycerides, cholesterol, and phospholipids. Triglycerides are compounds of fatty acids with glycerol and are the primary form in which fats are obtained through food and stored in the human body. Cholesterol belongs to the class of lipids known as sterols and is found exclusively in animal organisms. Cholesterol along with phospholipids make up the bilayer of all biological membranes. Fats are also classified as saturated or unsaturated depending on the chemical structure of the fatty acids involved.

• Vitamins

Vitamins are organic substances that are generally classified as either fat soluble or water soluble. Fat-soluble vitamins (vitamin A, vitamin D, vitamin E, and vitamin K) dissolve in fat and tend to accumulate in the body. The body stores these vitamins in fatty tissue and the liver and reserves of these vitamins can stay in the body for days and sometimes months. Water-soluble vitamins (vitamin C and the B-complex vitamins, such as vitamin B6, vitamin B12, and folate) must dissolve in water before they can be absorbed by the body, and therefore cannot be stored. Any water-soluble vitamins unused by the body are primarily lost through urine. Because of the above, people need a more regular supply of water-soluble vitamins than fat-soluble ones.

• Minerals

Minerals (dietary minerals) are inorganic chemical elements present in soil and water, which are absorbed by plants or consumed by animals. They are necessary for normal cellular activity, heart and brain function. Minerals are used as building materials for body tissues and are components of hormones and enzymes involved in the regulation of metabolism. Minerals are divided into two separate categories: macronutrients or main minerals (calcium, phosphorus, potassium, sodium, and magnesium) which are required in amounts greater than 100 mg per day and micronutrients or trace elements (iron, iodine, copper, zinc, chromium, fluoride, molybdenum, manganese and selenium) which are required in smaller amounts. Mineral-rich foods include nuts, seeds, shellfish, cruciferous vegetables, eggs, beans, and cocoa.





c6) Talking about Microorganisms

Microorganisms, termed because of their size (micro meaning small and organism meaning living being) are the tiniest forms of life. Including bacteria, yeasts, molds and viruses are found all around us and they are met in our kitchens while cooking as well.

Bacteria are the most important microorganisms to the food processor. Most are harmless, many are highly beneficial, some indicate the probable presence of filth, disease organisms, spoilage and a few can make us sick. To see them, you need a microscope that magnifies about 1000-fold. Bacteria can be extremely resilient, surviving through harsh conditions They grow in warm, moist environments but are slowed by high heat, cold temperatures, low pH and high salt or sugar.

Yeasts are oval-shaped and slightly larger than bacteria. Molds as found on bread, fruit, damp paper, or other surfaces are actually composed of millions of microscopic cells joined together to form chains. Molds can thrive in conditions too adverse for bacteria or yeasts. They reproduce by spores that are frequently present as green or black masses on the protruding hyphae. Yeasts and molds grow on most foods, on equipment, and building surfaces where there are small amounts of nutrients and moisture.

Microbial reactions due to bacteria and yeasts have been essential to the development of our whole cuisine. A very important one of them is the process of fermentation.

Fermentation is a metabolic process that converts carbohydrates, such as sugars and starches, into alcohol or organic acids using microorganisms like bacteria, yeast, or fungi. It is a natural and ancient method used in various cultural practices for food and beverage production. Fermentation can enhance the flavor, texture and nutritional value of foods and is used as an effective method in preserving foods.

There are 3 types of fermentation:

- Alcoholic Fermentation: Yeast converts sugars into alcohol and carbon dioxide. This process is utilized in the production of beer, wine, and other alcoholic beverages. The presence of alcohol inhibits the growth of spoilage microorganisms.
- Lactic Acid Fermentation: Lactic acid bacteria convert sugars in food into lactic acid. This type of fermentation is commonly employed in the production of yogurt, sauerkraut, and pickles. This is one of the most common types of microbial food preservation.
- Acetic Acid Fermentation: Acetic acid bacteria transform alcohol into acetic acid, leading to the production of vinegar. The acidic environment produced by acetic acid inhibits the growth of spoilage organisms, contributing to the preservation of foods.

To ensure successful food preservation, fermentation must occur under controlled conditions, including appropriate temperature, pH, salt concentration, and oxygen levels. These conditions can vary depending on the type of microorganism and the desired product.





9. Tools to assess skills and competences of persons included in the learning activity

a) Importance of assessment in educational process

The role of the Assessment in the project Science of Cooking is following a principle that the assessment is part of the learning process to ensure that progress of learner is monitored, thus providing a valuable feedback information on learner's achievements as well as efficiency of the specific learning activity and information about the need for individualisation or adaptation for each participant.

Assessment is a vital and powerful force in teaching and learning. Assessments shape what individuals learn and what educators choose to teach. The feedback inherent in any form of assessment has a significant educational role shaping motivation and future learning.

Assessment helps monitor students' progress and contributes to enforcing the assessment triangle, i.e., observations, interpretations of that observation, and understanding of that observation. Any breakdown can be noted by educators when reviewing their students' work. By analysing the breakdown in cognition, educators create a solid foundation for learning







(Westwood & Griffin, 2013)





Tools to be used in an assessment phase of the learning activity should be adapted to the learner specifics, which is in the case of the Science of cooking project, that the learners are adult persons with intellectual disabilities. Tools should reflect a starting level of specific skill or competence and indicate progress that was clearly shown after the activity.

In the project Science of Cooking we will assess skills and competencies of the persons who were involved in the learning activity. The assessment will be carried out four times. Two times from an educator's perspective and two times from the learners themselves. Both will assess their skills and competences prior and after the activity. In addition, learners will assess their state also during the workshop itself.

Almost half a century ago, David Ausubel suggested that the most important factor influencing learning is what the learner already knows, that teachers should ascertain this, and teach accordingly.

(Ausubel in Wiliam 2011)

The aim of this chapter is to present a tool that is useful to assess skills and competences of each individual participant that will take a part of the learning activities. In order to develop a meaningful tool, it is essential to first look at the differences in the definitions of skill and competence.

Skills and Competences

Research through literature shows that the definitions of mentioned expressions varies from literature to literature, year to year, even country to country. For example in the article by Orinos Skills and competencies we can read a definition set in 2001 by Gammelgaard and Larson: skills cover general, context independent knowledge; competencies, on the other hand, refer to experience based and context dependent knowledge. Taught in most classes, skills are general tools and rules that are vital for the practitioner. However, to reach a competence level, practitioners acquire context dependent knowledge through organizational experience (Orinos, 2012). Further in the article one can read about different approaches to the terms set by different experts, which are often linked to a specific needs. For example when employer is hiring, the company will define a list of competences and skills a candidate should possess in order to be hired for the job he or she is applying for.

Sandy Leitch, for example, took an approach, where she identified basic and generic skills. In her Review of skills (2006, p.6) she contended that skills are capabilities and expertise in a particular occupation or activity. Thereare a largenumber of different types of skillsand they canbe split into a number of different categories. Basicskills, such asliteracy and numeracy, and generic skills, such as teamworking and communication .







The definition in the context of European Qualifications Framework: skills

means the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the EQF, skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments);

competence

means the proven ability to use knowledge, skills and personal, social and/or methodological abilities, in work or study situations and in professional and personal development;

Another terms, closely connected to skills and competences are:

responsibility and autonomy

means the ability of the learner to apply knowledge and skills autonomously and with responsibility;

knowledge

means the outcome of the assimilation of information through learning. Knowledge is the body of facts, principles, theories and practices that is related to a field of work or study. In the context of the EQF, knowledge is described as theoretical and/or factual;

learning outcomes

means statements regarding what a learner knows, understands and is able to do on completion of a learning process, which are defined in terms of knowledge, skills and responsibility and autonomy.

(The Council of European Union, 2017)

In the document of the European commission *Explaining the European Qualifications Framework for Lifelong Learning* we can read the motives for defining the terms the way they are and also that there are blurred lines among them (beside skills and competences, EQF also differentiate a term knowledge):

The EQF's differentiation between knowledge, skills and competence can therefore be seen as a pragmatic agreement between the various, widespread approaches and does not oblige countries to do the same. National or sectoral frameworks or systems may require different approaches, taking into account specific traditions and needs [...]

Nevertheless, these three categories (KSC) should not be read in isolation from each other, but they should be collectively perceived. Thus, to grasp the characteristics of one level requires also 'horizontal reading' [...] Similarities may exist between the categories (e.g. the column 'competence' includes certain skills; the column 'skills' also contains certain forms of knowledge) but this is in the nature of them.

(European Commission, 2008)





The understandable way of defining and providing examples by HAYS (HAYS, 2024) could also be useful in our project Science of cooking:

Skills

Definition: Specific learned abilities that you will require to perform a given job successfully. Examples: Handling accounts; coding; welding; writing tenders; computer programming; foreign language proficiency.

Competences

Definition: Knowledge and behaviours that lead you to be successful in a job.

Examples: Analytical ability; problem-solving; initiative; negotiation; improving business processes; strategic planning; data-based decisions.

When identifying competences within Science of Cooking project, we also took into account the 8 key competences for lifelong learning. The recommendation identifies eight key competences essential to citizens for personal fulfilment, a healthy and sustainable lifestyle, employability, active citizenship and social inclusion.

(See Chapter 7, paragraph I. of this Document) (European Commission, 2019)

Taking these definitions as basis for differentiation on skills and competences in the Science of Cooking project, we will present skill as specific knowledge or ability learned or possessed. In the Science of Cooking project, the example of skills would thus be: understanding the recipe, ability to measure the quantity of individual sessions, subtracting, understanding the physical phenomena and chemical reactions, ability to observe, predict, experiment, conclude and communicate. While the term competence will serve as a general expression under which specific skill is identified, for example: literacy, mathematical competence, competence in chemistry, confidence, communication.







Assessment in Science of Cooking Project

Assessment in Science of Cooking project will be implemented in several parts. One part aims to the educators, second part aims to the participants – persons with ID.

The first part, for educators, is a precise questionnaire with specified skills and competences and an educator will be required to fill it in two times – prior to activity and after.

Participants will be asked to fill in questionnaire prior and after the workshop. This tool is highly inspired by A hero's journey tool and its aim is, to emphasise the importance of each participant and help them to acknowledge in more details how they felt and what they were experiencing during the workshop. In that way, the facilitator of the workshop will have a systematic overview about the effect and impact of the workshop and will be able to monitor progress as seen from the participant's perspective.

The tool is adapted in a way, that is understandable but also leaves space for learners to express expectations, new gained knowledge, their emotions and to evaluate their overall experience during the workshop.





After they finish a workshop each participant will get a **Certificate** with the skills they have practiced during the workshop and the competences they have gained, enhanced or improved during the workshop.

The tools that will be used to assess learners motivation are focused on specific skill and competence directly linked to the developed activity as well as general competence or skill, which may be enhanced in the type of workshops, which are prepared for a group of people to participate simultaneously and those are the types that Science of cooking is aiming for (example of skills and competences in that type of environment: teamwork, motivation, confidence, creativity, positive self-image, self-esteem, information exchange and communication).

The structure of the tool is prepared for the educator to assess participant's level of skills and competences as well as level of progress. It should be easy-to-use and understandable in order to leave an open space for debate with the participants, if they express the need or wish to follow up on their own skills and competences.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



b) Why are assessment tools important in the project Science of Cooking

With systematic monitoring of the progress in different fields an educator gets a valuable feedback information regarding the activity as well as participant. One of the project's objective is to improve the knowledge and skills of educators in the field of providing innovative educational contents for persons with intellectual disabilities. Thus, the assessment tool is an important element in the learning process, which provides an option to analyse their work, the content of the activity and the engagement on several different field of a learner. With the help of the assessment tool educators can improve their work and have a clearer vision for the adaptation of the learning content in the future implementations.

Another important step in the learning process is self-assessment of the learners themselves. The tools developed for the learners are presenting a path, which individual learner follows and monitor him or herself. With the tools the learner is presented to, he or she will get better understanding of the importance of the content of the activity and also a deep look on how he or she was acting or reacting in specific situation and what kind of emotions were awoken during the workshop. In the project we want to increase independence of persons with intellectual disabilities. By including them in the process of assessment this objective is being highly addressed, because they will have an opportunity to assess themselves independently and also understand that how they feel, evaluate and rate themselves is an important component towards the independence.

Science of Cooking is aiming towards a holistic assessment approach, meaning, that all active sides will be included and that the competences and skills which will be assessed and thus included in both types of tools will also address a wider field. As the project is aiming to improve foremost the skills in the STEM field, the skills and competences of this field will be in the focus, but in order to observe the whole picture and assess for example a level of independence of an individual is also important. The tools provided are suggesting to assess identified skills and competences as well as general outcomes, such as: impact, relationship, opinions, and experience.







c) STEM learning through cooking questionnaire with specified skills and competences for educators

Example of the assessment tool for educator:

Instructions for the educator:

Evaluate the performance of the participant with a mark from 1 to 3

- 1 the learner can only do it with a lot of help and support from educator has a low level of the assessed skill/competence
- 2 the learner can do it with a minimal support from educator has a medium level of the assessed skill/competence
- 3 the learner can do it independently has a good level of the assessed skill/competence

This tool should be used two times in each learning activity, prior and after the activity. After the activity, please, list a specific skill, that individual gained or improved by participating.



d) STEM learning through cooking questionnaire for persons with intellectual disabilities

Tools to self-assess for persons with ID

Simple and effective questionnaires provide information for statistic analysis and ability to monitor the effect of the activity as seen from the perspective of the participants.

A part of the questionnaire is thus prepared to assess current emotions and state of mind of participants. A current state of mind can have an effect on the motivation in participating in the workshop and subsequently may cause lower effect for the learner to reach the objective of the workshop. Thus, it is important to monitor how a person feels before joining the activity, especially an activity where he or she is expected to actively participate and learn new things.







e) A Hero's journey

A hero's journey is a tool usually used to analyse literature, motivate storytelling, to selfassess a persons life and thus gain a profound insight of one's trauma or past obstacles or simply understanding of one's behaviour and deepen self-understanding.

The origins of this tool goes to American anthropologist and professor of literature Jospeh Campbell. He described A Hero's journey (also known as monomyth) as an archetypal motif that is found again and again throughout all the world's literatures.

(Campbell, 2003)

lourney, 2021)

Different philosophers have narrated this in various stages. Joseph Campbell gave 17 stages of the hero's journey. Another professor, David Adams Leeming, and an American author, Phil Cousineau, gave their own version of 8 stages for the hero's journey.

In 2007 author and Disney screenwriter Christopher Vogler came up with 12 stages to the hero's journey. Vogler narrowed down the steps from 17 to 12 and named them differently. And though the book is meant as a guideline for screenwriting and quality storytelling, his division became popular by many other experts, teachers included.

(Vogler, 2007)

Moreover, the division of the steps are also applicable fort the assessment and is in that way useful for the Science of cooking project but with necessary adaptations.

Steps in the Hero's Journey by Vogler:

- Ordinary World This is where the Hero's exists before his present story begins the safe place.
- Call To Adventure The Hero's adventure begins when he receives a call to action, such as a direct threat to his safety, his family, his way of life or to the peace of the community in which he lives.
- **Refusal Of The Call** Although the Hero may be eager to accept the quest, at this stage he will have fears that need overcoming. Second thoughts or even deep personal doubts as to whether or not he is up to the challenge.
- **Meeting The Mentor** At this crucial turning point where the Hero desperately needs guidance he meets a mentor figure who gives him something he needs.
- **Crossing The Threshold** The Hero is now ready to act upon his call to adventure and truly begin his quest, whether it be physical, spiritual or emotional. He may go willingly or he may be pushed, but either way he finally crosses the threshold between the world he is familiar with and that which he is not.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



Steps in the Hero's Journey by Vogler:

- Tests, Allies, Enemies Now finally out of his comfort zone the Hero is confronted with an ever more difficult series of challenges that test him in a variety of ways. Obstacles are thrown across his path and he must overcome each challenge he is presented with on the journey towards his ultimate goal. He needs to find out who can be trusted and who can't. He may earn allies and meet enemies who will, each in their own way, help prepare him for the greater ordeals yet to come. This is the stage where his skills and/or powers are tested.
- Approach To The Inmost Cave The inmost cave may represent many things in the Hero's story such as an actual location in which lies a terrible danger or an inner conflict which up until now the Hero has not had to face. As the Hero approaches the cave he must make final preparations before taking that final leap into the great unknown. He may need some time to reflect upon his journey and the treacherous road ahead in order to find the courage to continue.
- **Ordeal** The Supreme Ordeal may be a dangerous physical test or a deep inner crisis that the Hero must face in order to survive or for the world in which the Hero lives to continue to exist. Even if he is facing his greatest fear, the Hero must draw upon all of his skills and his experiences gathered upon the path to the inmost cave in order to overcome his most difficulty challenge.
- **Reward (Seizing The Sword)** After defeating the enemy and finally overcoming his greatest personal challenge, the Hero is ultimately transformed into a new state, emerging from battle as a stronger person and often with a prize. The Reward may come in many forms: an object of great importance or power, a secret, greater knowledge or insight, or even reconciliation with a loved one or ally.
- The Road Back This stage in the Hero's journey represents a reverse echo of the Call to Adventure in which the Hero had to cross the first threshold. Now he must return home with his reward but this time the anticipation of danger is replaced with that of acclaim and perhaps vindication, absolution or even exoneration. But the Hero's journey is not yet over and he may still need one last push back into the Ordinary World. The moment before the Hero finally commits to the last stage of his journey may be a moment in which he must choose between his own personal objective and that of a Higher Cause.
- **Resurrection** This is the climax in which the Hero must have his final encounter with danger. Ultimately the Hero will succeed, destroy his enemy and emerge from battle cleansed and reborn.





• Return With The Elixir - This is the final stage of the Hero's journey in which he returns home to his Ordinary World a changed man. He will have grown as a person, learned many things, faced many terrible dangers and even death but now looks forward to the start of a new life. His return may bring fresh hope to those he left behind, a direct solution to their problems or perhaps a new perspective for everyone to consider. The final reward that he obtains may be literal or metaphoric. It could be a cause for celebration, self-realization or an end to strife, but whatever it is it represents three things: change, success and proof of his journey. The return home also signals the need for resolution for the story's other key players. The Hero's doubters will be ostracized, his enemies punished and his allies rewarded. Ultimately the Hero will return to where he started but things will clearly never be the same again.

Who is the hero by Jospeh Campbell's analysis and applicable for the project Science of cooking "journey through the workshop":

- Traditionally the hero might be a warrior, the ideal of strength, or of courage; an explorer, the founder of civilizations; a philosopher, an adventurer of the mind, the artist, the scientist;
- The journey is essentially the same for all mentioned heroes;
- The hero is the one who responds to the call to adventure;
- But no one can go to a journey alone. Everyone needs a mentor to provide wisdom and magical power;
- The descent into the underworld of adventure is often blocked by strange and dangerous threshold guardians. They mark the point of no return;

- Beyond them is the region of the unknown, a dream-like labyrinth of tests and trials;
- To pass this initiation, the hero must become a dragon-slayer; to seize the treasure, or rescue the princess;
- He is challenged to follow the path of his heart;
- With the newfound wisdom and experience gained from his quest, the hero returns to the world above with the power to bring about its renewal and salvation.





We chose this form as an inspiration to develop an assessment tool for persons with ID because is an engaging tool that makes an individual a hero and presents certain workshop as the story in an individual life. It helps the participant to truly empathise with his/her experience and to imagine him/herself as a hero on a special path that life has brought him/her. In the case of this project, this path will be a cooking workshop, where the individual will also learn and acquire new skills in STEM.

Science of Cooking project took the scheme of Vogler's steps and made adaptations in order to make it clear, easy to read and fill in and informative as well as engaging and fun for the learners.





Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731



The Hero's Journey in Science of Cooking project

The Hero's Journey in Science of Cooking project has 4 steps

- First step is Attendance. Learner is about to join in a workshop to gain new skills and experiences.
- Second step is Preparation. It is a stage prior to the workshop, in which the learner reflects on his/her fears, doubts, expectations and skills he/she has to enable them to take a part in the activity.

In this step is an opportunity to ask participants if they felt any self-doubt or other discouraging emotions before participating in the workshop; whether they felt confident and encouraged to take part in the workshop and did it help to know, that they will have an educator present to lead them through tasks. They will think about what they expected when attending the workshop.

• Third step is Participation. This is the core stage of the journey. Learner's active participation in the workshop. When filling in the Hero's Journey scheme learners will reflect on what they felt during the workshop, which skills were required, what they were learning, how did they feel during the workshop ...

This is the stage where learners will think about which skills they used in the workshop. They will assess where they felt they did a good job.

This step will also give an opportunity for learners to assess their emotions through the activity.

• Fourth step is Impact. This stage is after the activity. While fillin in the Hero's Journey's scheme, learner will make a provision of what impact the workshop left for the forseable future.

In this stage, learners will reflect upon new gained skills and assess whether they feel more independent now and if they will be able to use new gained skills and knowledges in the future.

They will reflect on their emotions after the workshop. How do they feel in comparison to how they have felt before and during the workshop.

For the Science of Cooking project, we have simplified and adapted all these steps so that they are easy to understand and help the learner to analyse or evaluate his/her pathway.

It is important that after the activity itself, each individual will assess the skills and emotions before and during the activity, and also reflect on the impact on his/her life after the activity and in the foreseeable future.







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Science of Cooking Project Nr. 2023-1-SI01-KA220-ADU-000154731

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Science of Cooking

Project Nr. 2023-1-SI01-KA220-ADU-000154731





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