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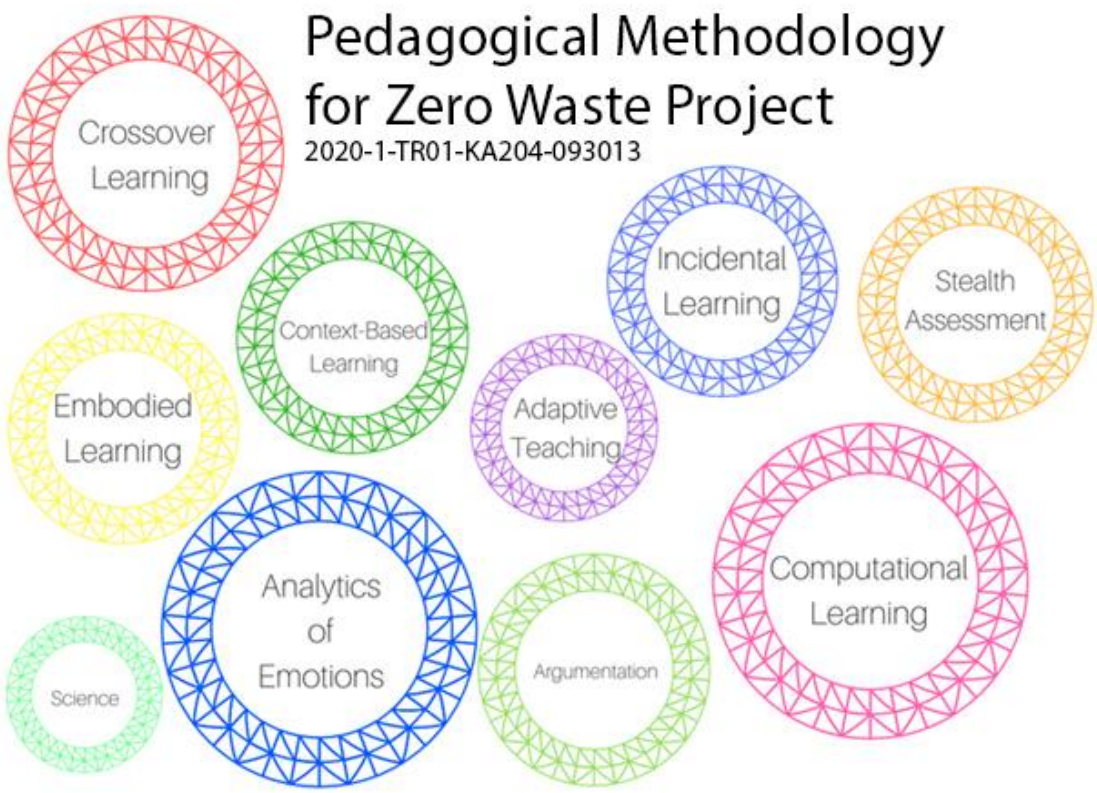

Project	Building adult skills in the Zero-Waste circular economy in Europe (Zero-Waste)
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Q1A2 – Pedagogical Methodology

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Content

1. Summary

The project aims to: identify the current development of Zero Waste Circular Economy in the EU area, **to create an innovative curriculum and design a training guide** to increase adult learners' skills in Zero Waste Circular Economy inclusive recycling methods, to meet the requirements of labour market and municipality that help to **develop Zero- Waste Cities**. The project also seeks to show **the model's opportunities in self-employment, jobs, and entrepreneurship**. We strive to build **adult competencies in circular design and sustainability.**

The curriculum will include the concepts of Zero-Waste Circular Economy (CE) and Zero-Waste cities, recycling/reuses, methods for food waste, glass, plastic, paper, cardboard, packaging, fabric, metal composite and electronics wastel, as well as other organic waste

The project's goal is to change behaviors and ensure that regions maximize recycling in the most cost-effective way through **a combination of teaching, educational resources and IT**.

To achieve these goals, the target groups are:

- Adult educator (primary),
- Municipalities,
- SMEs and entrepreneurs;
- Professionals who are in the process of starting a company in CE context.

The project will produce three original intellectual results:

- Baseline report, **innovative curriculum, and training modules** for adult educators
- IT-related resources and toolbox to support pilot training
- European Zero-Waste handbook with an entrepreneurship handbook

This report is based on work done on the ZeroWaste project, on future project activities, on the educational and psychological literature and guidance for the **innovative curriculum and training modules** for adult educators.

A pedagogical methodology is **a set of procedures that a teacher can develop to help all adult educators to learn**. A methodology is seen as something you can't get for the rest of the world. On the contrary, it is a complex mixture of **instruction, personal experience and reflection**.

The report creates a **framework for the procedures**, based on the experience of previous partners and on the new methods and pedagogical approaches relevant after the Covid-19 pandemic.

The report provides **thirteen suggestions for a modeling methodology: (1) Create clear goals** and plan how koncept and ideas develop during the activities, anticipating learning difficulties; **(2) Elicit and verbalize** the perceptions of adult educators; **(3) Promote interaction, collaboration,** and group cohesion; **(4)** Provide **prompt feedback**; **(5) Encourage self- and group** formative assessment; **(6)** Go from a **concrete to an abstract perception; (7) Verbalize** topics forcircular economy and waste; **(8)** Promote schematic drawing and writing as **"tools to think with"; (9) Building the transition** from direct computations to algebraic reasoning, from speech sensing to symbol sensing, from speech to facts and case studies; **(10) Explore** multiple representations; **(11)** Make abstract objects as concrete as possible **but discover the differences between the "real thing" and the representation; (12) Balance your** discovery and exploratory learning with guided learning; **(13) Anticipate, control and revise** the consistency of models and data.

Keywords:

Pedagogical/Teaching Methodology; modelling in science and circular economy; outresearch learning; online teaching and learning with computers; collaborative work; teacher training; teacher; entrepreneurs and adult educator education.

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2. Introduction

Transmitting information about the Circular Economy and Zero Waste to people in a way that encourages them to sustainably adopt concepts and practices as well as to support a transition from the linear economy demands more than simply lecturing people. It demands deep reflective activities as well as activities that put people's knowledge to test and practice in a way that leads them to use this knowledge in their daily lives. It demands therefore that teaching goes beyond informing towards leading to mindset changing, which is the most sustainable manner to encourage urgent behavioral changes.

Indeed, the Ellen McArthur Foundation[1] states that:

> *The transition to a circular economy is dependent on how individuals and organisations learn to innovate and apply what they've learned in the real world.*
>
> *The education sector, from primary school to postgraduate study, plays a vital role in ensuring students of all ages are equipped with the key skills and knowledge to apply circular thinking in their chosen careers.*

With this in mind, it is encouraged that the ZeroWaste project's pedagogical methodology is conceptualized around the following structure:

1. Transmit information supported by reliable references, including data and facts.
2. Encourage learners to reflect on the information just showed to them.
3. Transmit follow-up information if applicable.
4. Show inspirational actions/behaviors/practices through case studies that can illustrate how they can change the actions/behaviors they have reflected upon to adopt circular practices in their lives and support change in their contexts.
5. Include activities that allow learners to put the knowledge into practice. This may include role playing, going somewhere, being on the context, being on the situation, etc.

As such, throughout each module and/or relevant topic, it is recommended that the learners are introduced to three kinds of activities:

- Reflection
- Seeing how change/circularity/zero waste can look like
- Learning by doing.

In line with this, this document provides inspiration of activities and methodologies to apply in relation to the above.

In short, some key points to be considered while creating the content of the training content may be summarized as follows:

[1] Available at: https://ellenmacarthurfoundation.org/resources/education-and-learning/overview

- Include good reference papers and data sources to provide knowledge about CE and zero waste topics.
- Include case studies, data, numbers (concrete information) to stimulate knowledge around CE and zero waste topics (abstract information)
- Provide space/time for feedback and assessment
- Ask open-ended questions, re-state remarks in more scientific language, and develop and use models to construct explanations.
- Explore the tools/techniques which will be further detailed in this document.
- Include interactive cooperative group activities when suitable
- Encourage self-reflection (to lead to incidental learning) and professional growth around CE topic
- If relevant, include activities that give opportunities to go out of the classroom or away from the computer
- If relevant, include activities that encourage computational thinking by decompose problems to reach to the root and fully understand it
- Include activities that encourage “learning by doing”
- Include exploration activities such as flipper classroom, project-based learning, cooperative learning, gamification, problem-based learning, design thinking, thinking-based learning, competency-based learning.

3. Project background

The last 150 years of industrial development have been dominated by a one-way or linear model based on the **principle of "take-make-waste"**. This model has caused a great dependence on scarce resources, environmental pressures and huge mengder waste. Our planet has limited resources which cannot sustain the needs of a population of 9.7B until 2050. Society needs to rethink and reshape how we work at all levels of the process of action. It is therefore necessary to develop a new economic model called **the "Zero-Waste Circular Economy".**

A sustainable bioeconomy is the renewable segment of the circular economy. If consumers reduce food waste by 50% by 2030, the bioeconomy could create innovations within land use – which is currently used to feed animals – can feed another three billion people. Across Europe, in response to the growing waste and climate crisis we face, a growing number of policies and strategies are being adopted.

Together with environmental benefits, a **growing circular economy offers great potential for jobs** by reducing unevenness in regions with high unemployment in Europe and increasing material productivity. De current occupationna in the circular economyn in Europe (in the repair, waste, e.g.tervinning, rental and leasing industries) is estimated at at least 3.4 million.

It is expected that CE in Europe will create green entrepreneurs and 1.2 million work opportunities by 2030. The concept of Zero-Waste CE has become popular and important; however, there is neither an innovative curriculum nor specific indicators

dedicated to it in regional policy for adult learners in Europe.

Making the transition to Zero-Waste CE requires a great need for **new skills, competencies and approaches**. Improving existing skills is at least a similar to an importantt as developing brand newskills. Complementing general skills with Zero-Waste CE skills can make a big difference and help with the development of skills needed in Zero-Waste CE.

A complete transition to Zero-Waste CE is not possible without professionals with a new way of understanding the economy, a comprehensive knowledge of the circular business models and new skills, tools and skillsto develop circular strategies.

4. The 2000s are for the digital initiatives.

In the world of digital skills in education, so teachers' focus should be on developing these skills and other pedagogical innovations in this area. Benefits of technology include increasing student motivation and being able to use more resources than just textbooks. The Zero-Waste project consists of innovative curricula and training modules that enable teachers to learn the knowledge, skills and attitude of the integration of technology into pedagogical decisions and research methodology.

The main focus of this report is to explore educational innovations to guide teachers and policy makers. The following was translated from the original online source and includes more about current pedagogy (Punia, V. n.d).

"In this era, **Pedagogy, Transaction and Evaluation** along with Flip classrooms Approach is equipped with technological supported pedagogical innovations. Digital skills and competencies will always be the ground which education of 21st century will grow and thrive. So this is need of the hour that teachers should focus on digital competence to explore **new pedagogical innovations** and new endeavours of Research methodology.

Educational needs of learners are changing faster than teachers can cope up with. We teachers have to welcome technology into our classrooms equipping students with new experiences. Technology helps make teaching, learning and research more meaningful and enjoyable. **There are number of powerful technology tools** in the classroom learning that teachers can use in the classroom that go beyond to the text books.

Technology has a way of keeping students motivated as well as engaged in what they are learning. It also has the ability to change the reluctant learners into passionate readers. Many teachers are shifting away from textbooks dependent classrooms and moving towards a **more student cantered, digital atmosphere driven by technology** in the classroom."

Source: https://sites.google.com/a/aicte-india.org/swayamrepo/pedagogical-innovations-and-research-methodology-interdisciplinary

5. Thirteen proposals for modeling methodology

In this report, the definition of FCTUNL, 2004 will be adopted, and an educational methodology is defined as a set of procedures that a teacher or lecturer can develop to help adult educators, managers and entrepreneurs involved in the circular economy learn through Zero-Waste training modules. The following was translated from the original online source and describes the thirteen suggestions for a good educational methodology.

" A methodology is something a teacher develops, based on his or her own experience and knowledge and on proposals made by others (scientists, peers, teachers' educators, etc.). A methodology is, then, a complex result of instruction, personal experience and reflection.

The following thirteen proposals highlight relevant procedures to help teachers build a coherent methodology.

Most proposals are illustrated with specific Modelling Space examples in the following pages.

1 **Make clear goals** and plan how concepts and ideas evolve during the activities, anticipating learning difficulties.
2 **Elicit and verbalize** adult educators' conceptions.
3 **Promote interaction**, collaboration, and group cohesion.
4 Give **prompt feedback**.
5 **Induce self and group** formative assessment.
6 Proceed from **concrete to abstract**.
7 **Verbalize** circular economy and waste topics.
8 Promote schematic drawing and writing as **"tools-to-think-with"**.
9 **Scaffold the transition** from direct computations to algebraic reasoning, from number sense to symbol sense, from number to facts and case studies.
10 **Explore** multiple **representations**.
11 Make abstract objects as concrete as possible but **spot the differences between the "real thing" and the representation**.
12 **Balance discovery and exploratory learning** with guided learning.
13 **Anticipate, check, and revise** the coherence of models and data."

Source:
https://moodle.fct.unl.pt/pluginfile.php/20500/mod_resource/content/0/diversos/D13_Development_of_pedagogical_methodology.pdf

6. Pedagogical and Teaching Methods – Learning

1. What is **pedagogy?**

According to Wikieducator.org (n.d.) pedagogy is:

"The study of teaching methods, including the aims of education and the ways in which such goals may be achieved. The field relies heavily on **educational psychology, which encompasses scientific theories of**

learning, and to some extent on the philosophy of education, which considers the aims and value of education from a philosophical perspective."

2. What is a **pedagogical methodology**?

According to a 2004 report by FCTUNL, an educational methodology is " a **set of procedures that a teacher can develop** in order to help all adult educators learn, not just those who learn almost spontaneously". Pedagogical methodology may be different; it can change over time and can consist of several important components, such as the personal characteristics of the teacher, competencies and classroomsenvironment etc. The most important are in anycase the factors that teachers can influence themselves. The report from FCTUNL then describes the 6 areas that teachers can influence. They consist of "Commitment to teaching, to adult educators and to their learning; knowledge of science and mathematics; knowledge of adult educators; knowledge of the art of teaching; science as a way of thinking and reflection; and professional growth."

The following text is available on the original report and describes it in more detail (FCTUNL, 2004):

"It is well known that most people assume that anyone who has studied can teach *("just remember your best teacher and do as he...")*. **This is probably true... for teaching, but not for learning.**

In fact, it is now also known that learning does not necessarily are Results of Teaching. In the report ScieNce for All (AAAS, 1989) for example, the authors wrote:

> *Cognitive research reveals that even with good instruction, adult teachers understand less than we think.*

" With determination, adult educators taking an examination are commonly able to identify what they have been told or what they have read; careful probing, however, often shows that their understanding is limited or distorted, if not altogether wrong.

Teaching can be easy, **but helping adult educators learn** is surely a not so easy task. Adult educators carry with them many **"learning obstacles"**, ranging from common science misconceptions to epistemological naïve thinking.
A **pedagogical methodology is seen, in this report**, simply as a **set of procedures that a teacher can develop** in order to help all adult educators learn, not just those who learn almost spontaneously.
Note the important verb **"develop"** in this statement: a methodology is not something one can receive from others. **It is the complex result of instruction, personal experience and reflection.**
Pedagogical methodologies can vary and change.
For example, some decades ago, reinforcing (the relationship between the incidence of behavior, the occurrence of a consequence, and the increased or decreased likelihood of that behavior occurring in the future) was seen as the essential aspect of a good methodology.
Nowadays reinforcement is still considered an important aspect but others are considered more relevant to learning. E.g., **exploring multiple representations** (verbal, graphical, analytical, etc., particularly in science and mathematics) and **concrete experience of abstract concepts** are two of current essential aspects to consider on an effective methodology.

Effective teaching is seen on the educational and psychological literature as having multiple components,

such as:

- Personal traits of the teacher;
- Teacher competencies;
- teaching methods;
- Classroom atmosphere;
- Teacher decision making-skills;
- Adult educator's previous knowledge and skills;
- Adult educator's characteristics.

The interaction between all these factors and the complexity of each make difficult (or impossible?) to assert which one is the single most important factor.
Some authors, such as Ausubel (1968) postulate that adult educators' previous knowledge is the single most important factor:

> *If I had to reduce all of educational psychology to one principle, I would say this: the most important single factor influencing learning is what the learner already knows. Ascertain this and teach him accordingly.*

Ausubel also introduced relevant ideas and concepts, such as:

- The distinction meaningful and rote learning;
- The most general ideas of a subject should be presented first and them progressively differentiated;
- Instructional materials must integrate new material with previously presented information;
- learning materials should be logically organized and potentially meaningful to learners.
- Anchoring new concepts into the learner's already existing cognitive structure make new concepts recallable.

In this report, we are particularly interested in those factors teachers can manage by themselves. For example, it is not possible for a teacher to have influence on most adult educators' characteristics (e.g., personal characteristics and family background).

Commitment to Teaching, to Adult educators and to Their Learning

Teachers acknowledge and value the individuality and worth of each student, believe that all adult educators can learn and demonstrate these beliefs in their practice.

Knowledge of Science and Mathematics

Teachers study continuously to have a broad and deep knowledge of the concepts, principles, techniques, and reasoning methods of mathematics and science (and the connections between them and with other fields of knowledge), and they use this knowledge to establish curricular goals and shape their instruction and assessment.

Knowledge of Adult educators

Teachers know and care about their adult educators, know how they learn and develop, understand the impact of home life and cultural background, and use this knowledge to guide their curricular and instructional decisions.

Knowledge of the Art of Teaching

Teachers have an extensive base of pedagogical knowledge to stimulate, motivate and facilitate student learning, using a wide range of formats and procedures to create environments in which adult educators are active learners, show willingness to take intellectual risks, develop confidence and self-esteem, and value knowledge.

Science as a Way of Thinking

Teachers develop adult educators' abilities to reason and think alone or with support from others, to investigate and explore patterns, to discover structures and establish relationships, to formulate and solve problems, to justify and communicate their conclusions, and to question and extend those conclusions.

Reflection and Professional Growth

Teachers reflect on what and how they teach and collaborate with others to strengthen the learning community.
Teachers acknowledge and value the individuality and worth of each student, believe that all adult educators can learn and demonstrate these beliefs in their practice.
In recent years, international studies such as the Trends in International Mathematics and Science Study (TIMSS, http://timss.bc.edu) and the Programme for International Student Assessment (PISA, http://www.pisa.oecd.org) have shown that most countries face complex problems with student learning in Science and Mathematics.
These studies are being used by governments and schools to promote changes in teaching and learning, not only in Europe but also in many other countries, including the US (see, e.g., http://nces.ed.gov/timss).

The famous **Pygmalion Effect** is a uniquely human phenomenon: **a persistently held belief becomes a reality.**
However, mathematics is very important for the understanding the economy, especially circular economy and technology development.

At least since late 1960s, the mastery learning and the formative assessment movements and, later, research-based teaching has shown that most if not all adult educators can learn, more concretely or more formally, the habits of mind, the concepts and the ideas of science and mathematics.

Theories: Like Howard Gardner's **Theory of Multiple Intelligences** (1983), recognize that all human beings have different intelligences, connected to core operations (e.g., logical mathematical, connected to number, categorization, and relations; spatial, connected to accurate mental visualization, mental transformation of images).
Different human beings have different degrees of each intelligence, but **all have some degree of all intelligences.**

Learning how to make circular economy models, in science in mathematics, can be done by all adult educators, with different degrees of success. For example, modelling with tables, as shown below, is easily grasped by all, but modelling with differential equations can only be done by formal thinkers, with a long training path.

Teachers know and care about their adult educators, know how they learn and develop, understand the impact of home life and cultural background, and use this knowledge to guide their curricular and instructional decisions.

Experienced teacher's supervisors know that those teachers who do not regularly study new and old things tend to have problems appreciating student learning difficulties.
That can be easily understood: **if someone repeats many times what he teaches, it becomes trivial and completely familiar to him.**

But if he is always studying, learning difficulties are constantly present and he can understand of how difficult it can be for adult educators to learn something they are not familiar with.
Traditional teachings methodologies were based on teaching the same, in the same conditions, with the same approach to all adult educators.
On the second half on the 20th century, **"teaching the same to all"** was discarded as a feasible methodology due to multiple factors (generalization of secondary studies, results of educational and psychological research, multiculturalism in schools, etc.).

The now dominant current practices recognize each student as a different learner, with different personal knowledge and skills. A good metaphor (suggested by Bruner, 1960) for the adult educators learning path is a spiral line. Different adult educators can be at different places on the spiral line, on each class. The spiral form suggests that learning progress is not linear and it happens with cycles and steps forward."

Source:
https://moodle.fct.unl.pt/pluginfile.php/20500/mod_resource/content/0/diversos/D13_Development_of_pedagogical_methodology.pdf

7. The 10 Innovative LearningTrategias of Modern Pedagogy

The following is available on a report by The Open University and SRI International that proposes ten innovative learning strategies for modern pedagogy (Sharples, M., Adams, A., et al. (2019), 2015).

1. Crossover Learning

Learning in informal settings, such as museums and after-school clubs, can link educational content with issues that matter to learners in their lives. These connections work in both directions. Learning in schools and colleges can be enriched by experiences from everyday life; informal learning can be deepened by adding questions and knowledge from the classroom.
These connected experiences spark further interest and motivation to learn. An effective method is for a teacher to propose and discuss a question in the classroom, then for learners to explore that question on a museum visit or field trip, collecting photos or notes as evidence, then share their findings back in the class to produce individual or group answers.
These crossover learning experiences exploit the strengths of both environments and provide learners with authentic and engaging opportunities for learning. Since learning occurs over a lifetime, drawing on experiences across multiple settings, the wider opportunity is to support learners in recording, linking, recalling and sharing their diverse learning events.

2. Learning Through Argumentation

Adult educators can advance their understanding of science and mathematics by arguing in ways similar to professional scientists and mathematicians. Argumentation helps adult educators attend to contrasting ideas, which can deepen their learning. It makes technical reasoning public, for all to learn. It also allows adult educators to refine ideas with others, so they learn how scientists think and work together to establish or refute claims.

Teachers can spark meaningful discussion in classrooms by encouraging adult educators to ask open-ended questions, re-state remarks in more scientific language, and develop and use models to construct explanations. When adult educators argue in scientific ways, they learn how to take turns, listen actively, and respond constructively to others.
Professional development can help teachers to learn these strategies and overcome challenges, such as how to share their intellectual expertise with adult educators appropriately.

3. Incidental Learning

Incidental learning is unplanned or unintentional learning. It may occur while carrying out an activity that is

seemingly unrelated to what is learned. Early research on this topic dealt with how people learn in their daily routines at their workplaces.

For many people, mobile devices have been integrated into their daily lives, providing many opportunities for technology-supported incidental learning. Unlike formal education, incidental learning is not led by a teacher, nor does it follow a structured curriculum, or result in formal certification.

However, it may trigger self-reflection and this could be used to encourage learners to reconceive what could otherwise be isolated learning fragments as part of more coherent and longer-term learning journeys.

4. **Context-Based Learning**

Context enables us to learn from experience. By interpreting new information in the context of where and when it occurs and relating it to what we already know, we come to understand its relevance and meaning. In a classroom or lecture theater, the context is typically confined to a fixed space and limited time.
Beyond the classroom, learning can come from an enriched context such as visiting a heritage site or museum, or being immersed in a good book.

We have opportunities to create context, by interacting with our surroundings, holding conversations, making notes, and modifying nearby objects. We can also come to understand context by exploring the world around us, supported by guides and measuring instruments.
It follows that to design effective sites for learning, at schools, museums and websites, requires a deep understanding of how context shapes and is shaped by the process of learning.

5. **Computational Thinking**

Computational thinking is a powerful approach to thinking and problem solving. It involves breaking large problems down into smaller ones (decomposition), recognizing how these relate to problems that have been solved in the past (pattern recognition), setting aside unimportant details (abstraction), identifying and developing the steps that will be necessary to reach a solution (algorithms) and refining these steps (debugging).

Such computational thinking skills can be valuable in many aspects of life, ranging from writing a recipe to share a favorite dish with friends, through planning a holiday or expedition, to deploying a scientific team to tackle a difficult challenge like an outbreak of disease.
The aim is to teach children to structure problems so they can be solved. Computational thinking can be taught as part of mathematics, science and art or in other settings. The aim is not just to encourage children to be computer coders, but also to master an art of thinking that will enable them to tackle complex challenges in all aspects of their lives.

6. **Learning By Doing Science (with remote labs)**

Engaging with authentic scientific tools and practices such as controlling remote laboratory experiments or telescopes can build science inquiry skills, improve conceptual understanding, and increase motivation.
Remote access to specialized equipment, first developed for scientists and university adult educators, is now expanding to trainee teachers and school adult educators. A remote lab typically consists of apparatus or equipment, robotic arms to operate it, and cameras that provide views of the experiments as they unfold.

Remote lab systems can reduce barriers to participation by providing user-friendly Web interfaces, curriculum materials, and professional development for teachers.
With appropriate support, access to remote labs can deepen understanding for teachers and adult educators by offering hands-on investigations and opportunities for direct-observation that complement textbook learning.
Access to remote labs can also bring such experiences into the school classroom. For example, adult educators can use a high-quality, distant telescope to make observations of the night sky during daytime school science classes.

7. **Embodied Learning**

Embodied learning involves self-awareness of the body interacting with a real or simulated world to support the learning process. When learning a new sport, physical movement is an obvious part of the learning process.
In embodied learning, the aim is that mind and body work together so that physical feedback and actions reinforce the learning process.
Technology to aid this includes wearable sensors that gather personal physical and biological data, visual systems that track movement, and mobile devices that respond to actions such as tilting and motion.
This approach can be applied to the exploration of aspects of physical sciences such as friction, acceleration, and force, or to investigate simulated situations such as the structure of molecules.
For more general learning, the process of physical action provides a way to engage learners in feeling as they learn. Being more aware of how one's body interacts with the world can also support the development of a mindful approach to learning and well-being.

8. Adaptive Teaching

All learners are different. However, most educational presentations and materials are the same for all. This creates a learning problem, by putting a burden on the learner to figure out how to engage with the content. It means that some learners will be bored, others will be lost, and very few are likely to discover paths through the content that result in optimal learning.
Adaptive teaching offers a solution to this problem. It uses data about a learner's previous and current learning to create a personalized path through educational content.
Adaptive teaching systems recommend the best places to start new content and when to review old content. They also provide various tools for monitoring one's progress.
They build on longstanding learning practices, such as textbook reading, and add a layer of computer-guided support.
Data such as time spent reading and self-assessment scores can form a basis for guiding each learner through educational materials. Adaptive teaching can either be applied to classroom activities or in online environments where learners control their own pace of study.

9. Analytics Of Emotions

Automated methods of eye tracking and facial recognition can analyze how adult educators learn, then respond differently to their emotional and cognitive states.
Typical cognitive aspects of learning include whether adult educators have answered a question and how they explain their knowledge.
Non-cognitive aspects include whether a student is frustrated, confused, or distracted.
More generally, adult educators have mindsets (such as seeing their brain as fixed or malleable), strategies (such as reflecting on learning, seeking help and planning how to learn), and qualities of engagement (such as tenacity) which deeply affect how they learn.
For classroom teaching, a promising approach is to combine computer-based systems for cognitive tutoring with the expertise of human teachers in responding to adult educators' emotions and dispositions, so that teaching can become more responsive to the whole child and learner.

10. Stealth Assessment

The automatic data collection that goes on in the background when adult educators work with rich digital environments can be applied to unobtrusive, 'stealth', assessment of their learning processes.
Stealth assessment borrows techniques from online role-playing games such as World of Warcraft, in which the system continually collects data about players' actions, making inferences about their goals and strategies in order to present appropriate new challenges.
This idea of embedding assessment into a simulated learning environment is now being extended to schools, in topics such as science and history, as well as to adult education.
The claim is that stealth assessment can test hard-to-measure aspects of learning such as perseverance, creativity, and strategic thinking. It can also collect information about adult educators' learning states and processes without asking them to stop and take an examination. In principle, stealth assessment techniques could provide teachers with continual data on how each learner is progressing.

Yes, we have seen methodologies raised by the past experiences of the researchers working in the field of

teaching and learning methodologies
But yet, not all of them are used at most. Let we look through the other techniques and methodologies developed by other researchers, teachers and lecturers in cooperation with private sector."

Source: https://ou-iet.cdn.prismic.io/ou-iet/22020571-3ef2-4d01-8ec3-3ad108dcb041_innovating_pedagogy_2015.pdf

8. The 8 methodologies that every 21st century teacher should know

An increase in digital technologies in classrooms has led to the development of many new teaching methods. Realinfluencers.es have looked at 8 of these, which are described below.

First, the reverse classroom, where the learning content is studied at home and processed later in the classroom, saving time in the classroom. Second, project-based learning that encourages students to learn skills and knowledge through projects that correspond to real-world problems. Third, cooperative learning is based on the idea that working in a group improves attention, engagement, and knowledge learning. Fourth, "gamification" introduces fun and popular elements of learning.

The fifth method is problem-based learning based on asking questions that lead to knowledge, which in turn leads to more questions. The giant method is Design Thinking which focuses on creation and innovation among students. After that, it wast ankebased learning which is about developing critical thinking **skills** instead of just memory skills. Finally, by using competency-based learning, students learn more practical applications of knowledge.

The following is translated from dan online sourcen by Redacción Realinfluencers (realinfluencers.se, 2019).

"New teaching methodologies are changing the educational environments around the world and driving better academic performance among adult educators. We go over some of the main innovative approaches that educators have forged over the last few years and that every 21st century teacher should be acquainted with.

Flipped Classroom

One of the modern methodologies that has gained more popularity in recent years, Flipped Classroom is a pedagogical approach in which the traditional elements of the lesson taught by the teacher are reversed – the primary educational materials are studied by the adult educators at home and, then, worked on in the classroom.
The main objective of this methodology is to optimize time in class by dedicating it, for example, to meet the special needs of each individual student, develop cooperative projects or work on specific tasks.

Project-Based Learning

With the arrival of new information and communication technologies to schools, both new teaching methodologies as well as new versions of existing methodologies, now revised and updated for the digital generation, have emerged. One of the most used in class at present is Project-Based Learning (PBL).
In its essence, PBL allows adult educators to acquire key knowledge and skills through the development of projects that respond to real-life problems.

The teaching based on projects or integrated tasks, is today the best didactic guarantee for an effective development of key skills while also acquiring the knowledge of the curriculum's content.
Starting from a concrete problem, instead of the traditional theoretical and abstract model, sees notable improvements in adult educators' ability to retain knowledge as well as the opportunity to develop complex competencies such as critical thinking, communication, collaboration or the problem solving.

Cooperative Learning

"**Stronger together**". This concept in a simple way cooperative learning, a methodology that teachers use to group adult educators together and, thus, impact on learning in a positive way.
The proponents of this model theorize that working in a group improves the attention, involvement and acquisition of knowledge by adult educators.
The final goal is always group-oriented and will be achieved if each of the members successfully perform their tasks.
The main characteristic is that it is structured based on the formation of groups of 3-6 people, where each member has a specific role and to reach the objectives it is necessary to interact and work in a coordinated manner.
In a cooperative learning context, the final goal is always common and will be achieved if each of the members successfully performs their tasks. On the other hand, individual learning has adult educators focusing on achieving their objectives without having to depend on the rest of their classmates.

Gamification

The integration of game mechanics and dynamics in non-ludic environments, or gamification, has been practiced for a long time. Over the past few years, however, and particularly due to the evolution of videogames, the phenomenon has gathered unprecedented dimension, and is one of the most talked about as a current and future trend of the EdTech industry.

Since, in the 80's, games with an international vocation such as the "Carmen Sandiego" series or "Reader Rabbit" have gained worldwide popularity, the development of educational titles has increased consistently. Not only those aimed at the general public but, ever more often, those specifically designed for adult educators and particular innovative curriculum and training modules.
This trend was consolidated with the increasing inclusion of gamification in school curricula, and it is estimated that this inclusion will continue to grow in the future.

Problem-Based Learning

Problem-Based Learning (PBL) is a cyclic learning process composed of many different stages, starting with asking questions and acquiring knowledge that, in turn, leads to more questions in a

growing complexity cycle.
Putting this methodology into practice does not only mean the exercise of inquiry by adult educators but convert it into useful data and information. According to several educators, the four great advantages observed with the use of this methodology are:

- The development of critical thinking and creative skills
- The improvement of problem solving abilities
- Increased student motivation
- Better knowledge sharing in challenging situations

Design Thinking

Education has always been a prolific space for innovation. Teachers all over the world are constantly coming up with new ideas and methodologies to introduce in the classroom making the best of the tools at their disposal.
Design Thinking (DT) applied stems from industrial designers and their unique method to solve problems and satisfy the needs of their clients.
Applied to education, this model makes possible to identify with greater accuracy the individual problems of each student and generate in their educational experience the creation and innovation towards the satisfaction of others, which then becomes symbiotic.

Thinking-Based Learning

Beyond the debate around the effectiveness of learning by memorizing facts and data when discussing education, one of the most talked about aspects is the need to show adult educators how to work with the information they receive at school. Teach them to contextualize, analyze, relate, argue…
In short, convert information into knowledge.
This is the goal of Thinking-Based Learning (TBL), developing thinking skills beyond memorization and, in doing so, developing effective thinking on part of the adult educators.

Competency-Based Learning

By definition, all learning methodologies have the acquisition of knowledge, the development of skills and the establishment of work habits as their main goals. Competency-Based Learning (CBL) represents a set of strategies to achieve this.
Through assessment tools such as rubrics, teachers can go through the academic curriculum without significant deviations but focusing it in a different way, putting into practice real examples and, thus, transmitting to their adult educators a more tangible dimension of the lessons.

Source: https://www.realinfluencers.es/en/2019/05/09/8-21st-century-methodologies/

9. Research-based pedagogical techniques

In 2019, Matthew Lynch wrote an article about the 31 pedagogical methods that every teacher should know. The following is available on the article in which he describes the important methods (Lynch, 2019).

“When it comes to teaching, your technique is everything.

Knowing what techniques and strategies to employ and when to use them, can mean the difference a student succeeding academically or experiencing academic failure. That is why it is important for all teachers to have a toolkit full of research-based pedagogical techniques that they can implement at a moments notice.

If you want to know what techniques you should place in your toolkit, keep reading. In this piece, we will discuss 31 pedagogical techniques that every teacher should have in their toolkit.

1. **Massed Practice:** A learning technique which involves the repetition of specific facts or skills over a concentrated period.
2. **Distributed Practice:** A learning technique which involves the repetition of specific items at intervals over a designated period.
3. **Learning Probes:** Techniques which assist teachers to ascertain whether or not adult educators understand a lesson. Questioning is an example of such techniques.
4. **Juxtapositioning Texts:** A technique that uses multiple texts to shed light on several perspectives on a given topic. Groups of adult educators each read a different text and discuss it. When finished, the adult educators are placed into new groups so that each text is now represented in the new group.
5. **Means-Ends Analysis:** A problem-solving technique in which the learner identifies the goal (ends), the present situation, and the method through which to attain the goal (means) to decrease the perceived gap between the ends and the means.
6. **Rule-Example-Rule:** A technique for teaching concepts in which the teacher presents a rule or definition through examples and then demonstrates how the examples fit the rule.
7. **Keyword Method:** A memory improvement technique which uses images to connect items into pairs.
8. **Loci Method:** A technique that assists in remembering lists by visualizing the items within familiar locations.
9. **Pegword Method:** A memorization technique which uses images to connect a list of facts to a familiar group of words or numbers.
10. **Initial-Letter Strategies:** Learning techniques which use the initial letters of specific items to change the item into a word or phrase that is easier to remember.
11. **PQ4R Method:** A study technique in which adult educators preview, question, read, reflect, recite, and review a given material or their work.
12. **Top-Down Approach:** A pedagogical method that encourages student input in their learning and emphasizes authentic learning activities in literacy instruction by including meaningful contexts.
13. **Analytic Process:** A reading technique designed to help teachers to observe and assess adult educators' engagement with the reading process. Teachers are then able to identify strengths and weaknesses and plan appropriate lessons regardless of the domain, teaching method, or curriculum involved.

14 **Morphological Synthesis:** A technique used to encourage creative problem solving which extends on attribute transferring. A matrix is created, listing concrete attributes along the x-axis, and the ideas from a second attribute along with the y-axis, yielding a long list of idea combinations.

15 **Implementation Charting:** An activity in which problem solvers are asked to identify the next steps to implement their creative ideas. This step follows the idea generation stage and the narrowing of ideas to one or more feasible solutions. The process helps participants to view implementation as a viable next step.

16 **Sketch and Label Connections:** A teaching idea designed to help adult educators express a connection through visual representations. Adult educators read the text and consider a connection that they can make, sketch the connection, and label it (text-self, text-text, or text-world). They must then explain why it is that type of connection. Sketch and label connections can be done before, during, and after reading a text.

17 **Semantic Map:** A teaching idea designed to engage prior knowledge, introduce content-specific vocabulary, and organize new information about a topic. In order to make a semantic map, the teacher or the student will choose a word. Adult educators will then brainstorm more information about that word, creating a graphic organizer with categories and details. These maps can be used to create summaries.

18 **Social Constructivist Process:** A learning development theory based on the schema that concludes that learning takes place when prior knowledge is combined with new information.

19 **Bookmark Technique:** A teaching idea that can help to monitor reading comprehension and make evaluative judgments about the text simultaneously. This technique can be used for in-class assignments and homework assignments using narrative and expository texts.

20 **Gallery Images:** A teaching idea designed to help adult educators make visualizations during a reading assignment and gives them a better way to share their mental images. Gallery images are usually used after adult educators are finished reading an informational text.

21 **Guided Imagery:** A teaching idea that encourages readers to tap into their prior knowledge, create visualizations, solve problems, and use their imaginations. This technique can be utilized with narrative or informational texts that elicit a mental image.

22 **INSERT Method:** A teaching idea designed to encourage adult educators to become engaged readers by inserting different symbols into the text. This gives adult educators an opportunity to reflect on what they know and make decisions about the different ideas presented in the text.

23 **"I Wonder…" Statements:** A teaching idea created to help encourage adult educators to ask more questions and to provide a model for active thinking while reading a given text. The statements can be used with any type of text either before, during, or after the reading. The "I wonder" statements can be made orally, visually, or in writing.

24 **KWL/KWLS:** A teaching idea that engages a student's prior knowledge about a topic by setting up the purpose for reading and confirming the original understanding of the topic. This is also a great time to revise or expand the original understanding. A traditional KWL chart requires readers to ask what they know, what they want to know, and what they have learned. A KWLS chart adds one additional column for adult educators to state anything they still want to know.

25 **Monitoring/Clarifying:** A reading comprehension strategy where the reader constantly asks whether the text makes sense to them and then implementing strategic processes to make the text clearer.

26 **Paired Questioning:** A teaching idea where adult educators take turns making questions and responding to those questions about a text.

27 **Photographs of the Mind:** A teaching idea designed to help adult educators share their mental images that they create while reading a text. They must stop at four designated points to sketch their mental images.

28 **Question-Answer Relationships:** A teaching idea proposed by Raphael that assists adult educators with self-questioning. There are two basic information sources: prior knowledge and the text they are reading. Within each of the information sources, adult educators will find question-answer relationships that help them to develop their self-questioning abilities and focus on the information sources necessary to answer the question. This technique can be used when reading both narrative and expository text.

29 **ReQuest:** A teaching technique created by Manzo (1969) where adult educators participate in an active discussion of a text. Adult educators will create questions at multiple levels based on modeling received from the teacher. Both adult educators and teachers will answer the questions.

30 **Thick and Thin Questions:** A teaching idea that encourages adult educators to ask questions about a given text and then discern what type of questions they are asking. The questions might be memory-level (thin) or evaluative (thick).

31 **Patterned Partner Reading:** A teaching idea that provides structure for strategic reading while working interactively with a partner. Two adult educators will take turns reading the text or a section of the text together."

Source: https://www.theedadvocate.org/31-pedagogical-techniques-that-every-teacher-should-have-in-their-toolkits/

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