“Reaching Education 5.0 via further teachers' training on upgrading green and digital competences of learners with disabilities and special needs via integrated phenomenon-based learning approach”

(TEACH-PHEN)

Work package n°2 - Project deliverables - training materials for teachers, students with mild disabilities and pilot realisation

RESULT 1 - “Teachers’ supportive handbook on phenomenon-based learning concept combining science, geography, mathematics, history”

FULL VERSION 3.0 / September, 2025

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Preamble

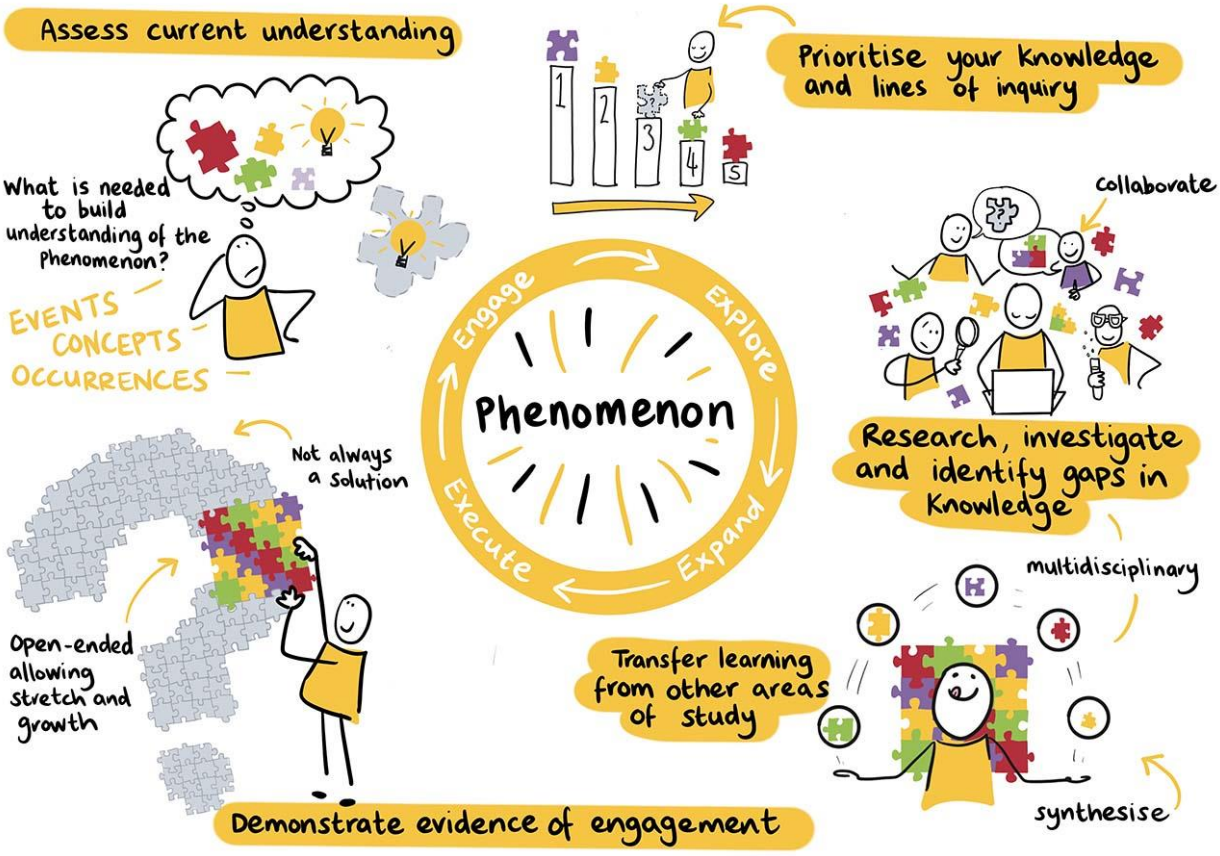
Welcome to the "Teacher's supportive handbook for Phenomenon-based learning"!

This comprehensive guide (full version) is designed to assist educators in teaching the 21st-century skills by integrating phenomenon-based learning into their teaching practice. It particularly focuses on the interdisciplinary approach that combines science, geography, mathematics, and history. The handbook includes knowledge and material for designing inclusive, phenomenon-based learning experiences and instruction that supports all learners, including those with disabilities and special needs.

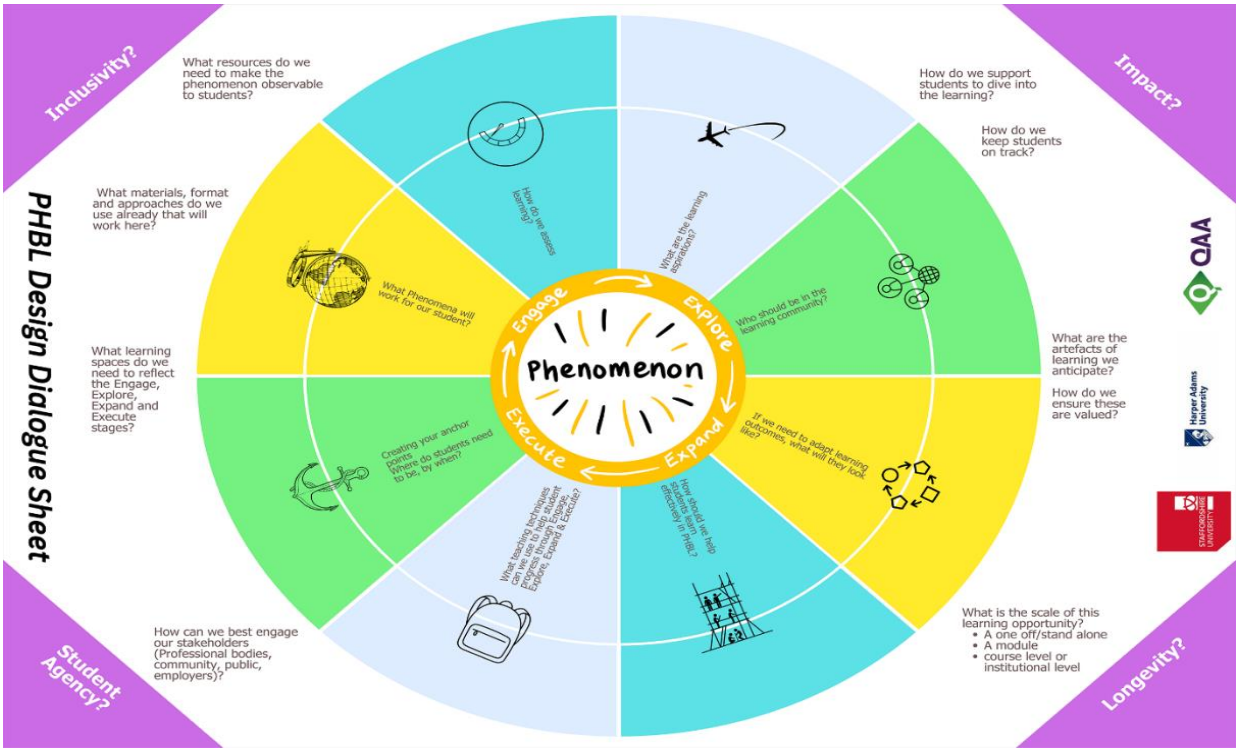
The pedagogy of this handbook is grounded in three key pedagogical concepts that aim to enhance the learning of 21st-century skills for all learners, including those with special needs. These approaches include phenomenon-based learning (PhBL), multidisciplinary learning, and Universal Design for Learning (UDL).

What is Phenomenon-Based Learning (PhBL)?

Phenomenon-based learning is regarded as an innovative way to teach 21st-century skills (Lonka, 2018a) and about complex issues like climate change (Yli-Panula et al., 2020). Phenomenon-Based Learning is an educational approach that centres around real-world phenomena or events as a starting point for learning. It encourages learners to explore complex issues interdisciplinarity from multiple perspectives. Along with subject-based knowledge, it fosters 21st-century skills, such as critical thinking, problem-solving and a deeper understanding of interconnections across various disciplines.



Source: Staffordshire University / Harper Adams University



Source: Staffordshire University / Harper Adams University

Why we combine Science, Geography, Mathematics, and History?

By integrating these four subjects, we aim to provide a more holistic view of the world. Through multidisciplinary learning, learners will learn how scientific principles interact with geographical landscapes and how historical events have been connected to mathematical developments, and vice versa.

This interdisciplinary approach enriches the educational experience and prepares learners with skills needed to navigate the complexities they encounter in real-world situations.

What does equity in education mean and how can I as a teacher foster it?

Equity in education is a fundamental objective highlighted by UNESCO (Ariza & Hernández Hernández, 2025) and the OECD (OECD, 2023). Equity is at the core of the Sustainable Development Goals (SDGs). SDG 4 aims to 'ensure inclusive and equitable quality education and promote lifelong learning opportunities for all' (United Nations, 2025). Additionally, the OECD (2023) emphasises that equitable education systems are crucial for enabling every student to reach their full potential regardless of their personal or social background. Equity in education means that every student is provided with the specific support they need for their learning. It should be distinguished from equality in education which indicates that all learners are provided the same instruction irrespective of their needs.

Equity in education provides the necessary support for everyone to learn

Source: Freepik

Well-designed support for learning is especially beneficial for learners with disabilities and special needs, who often encounter specific challenges such as difficulties with language, mathematics, and executive functioning in information-rich settings. From primary through higher education, these learners frequently lack the same opportunities for participation, engagement, and retention, e.g. in the disciplines of science, technology, engineering and mathematics and arts, as their non-disabled peers (see e.g. Ariza & Hernández Hernández, 2025; Griffiths et al., 2021). At the same time, studies show that learners with special needs often exhibit lower scores in most 21st-century skills than their peers and that these gaps typically widen until they reach postsecondary education (Vaknin-Nusbaum & Rachevs.ki, 2024). Consequently, it is essential to prioritise equity and inclusion in education to ensure that all learners have equal opportunities for future success.

Thus, it is crucial that the goals of disability and discrimination policies are aligned with teaching practices. This ensures that all students, including those with disabilities, can develop their competences and skills. In instruction, this can be supported by Universal Design for Learning (UDL) approach. This handbook incorporates UDL into phenomenon-based learning and shares knowledge and tools on how to make phenomenon-based instruction and learning more inclusive and accessible for all students.

How to use this handbook?

This handbook is intended to be a practical tool for recent and future teachers (those who are studying pedagogical subjects at bachelor's or master's degree level). Feel free to adapt and modify the materials to suit your specific needs and the unique characteristics of your learners. We encourage you to share your experiences and insights with colleagues to foster a collaborative learning community.

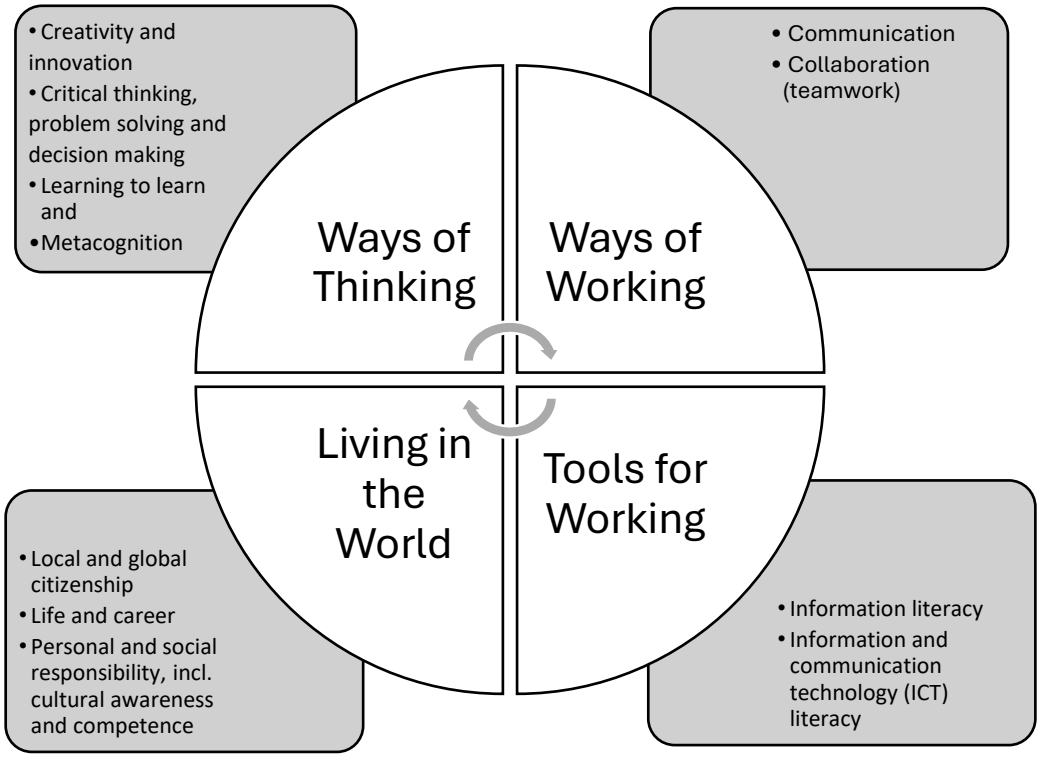
We hope this handbook serves as a valuable resource in your journey towards implementing PhBL in your classroom. By embracing this innovative approach, you are empowering your learners to become lifelong learners who can tackle complex challenges with confidence and creativity. For practical purpose, we also designed a short version separately.

We wish you a nice time exploring phenomenon-based learning! Happy teaching!

The TEACH-PHEN Consortium

Introduction to 21st Century Skills

Worldwide, the operating environments are constantly and rapidly changing. We are faced with lots of information and a data-intensive reality that is increasingly driven by algorithms. Additionally, we are increasingly confronted with complex phenomena and wicked problems in our current reality. These include, for example, sustainable development, climate change, and the global economic crisis, which are inherently interdisciplinary phenomena. Traditional subject-based teaching, which often focuses on memorising content knowledge, often falls short in preparing learners to face this reality. Solving the wicked problems and adapting to the current complex reality requires holistic, systemic and interdisciplinary thinking. Therefore, it is increasingly important to develop general information processing skills. Terminologically, these skills have been framed as 21st-century, transversal, generic or broad-based skills (Binkley et al., 2012; Halinen & Jääskeläinen, 2015; Lonka, 2018a). In this handbook, we refer to them as 21st-century or transversal skills. The 21st century skills can be broadly categorized into four main areas: 1) ways of thinking, 2) ways of working, 3) tools for working and 4) living in the world (Binkley et al., 2012).



The Framework of 21st -century Skills by Binkley et al. (2012)

The category "Ways of Thinking" encompasses the skills crucial for navigating the complexities of the modern world. Creativity and innovation involve generating, refining, and evaluating new ideas, and then implementing them effectively in collaboration with others. Critical thinking, problem-solving, and decision-making skills require the ability to reason, apply systems thinking, make informed judgments, and address problems by identifying knowledge gaps and posing meaningful questions. Learning to learn and metacognition focus on understanding one's own learning preferences, strengths, and weaknesses, and managing the learning process through goal-setting, time management, self-assessment, and critical reflection on learning experiences. (Binkley et al., 2012)

The category "Ways of Working" involves crucial skills for effective communication, collaboration and teamwork. Communication skills encompass both verbal and written proficiencies in the learner's native language and other foreign languages. This involves allowing individuals to listen effectively, articulate their thoughts clearly, make arguments and utilise various types of media to share ideas. Additionally, collaboration and teamwork skills involve working and interacting efficiently with other people and in diverse teams, utilising social and cultural diversity to foster creativity, managing projects, and guiding others towards shared goals. (Binkley et al., 2012)

The category "Tools for Working" includes skills such as information literacy and information and communication technology (ICT) literacy that equip individuals to navigate digital environments efficiently. Firstly, information literacy involves the ability to access, evaluate, and effectively use information, data and concepts from various sources deliberately and systematically. ICT literacy, on the other hand, refers to the ability to use digital technologies effectively and ethically to access, use, manage and communicate information. It also includes the ability to assess the usability of these tools and utilise them to solve problems, create new knowledge and media products. (Binkley et al., 2012) With the rise of Artificial Intelligence (AI), it has been suggested that 21st-century skills involve also AI-related competences, such as 1) innovation and creative design with and for AI, learning to act autonomously with and for AI and 3) co-creation with and through AI (Ehlers et al., 2023).

The category "Living in the World" encompasses skills essential for acting for democracy and navigating complex social and professional landscapes. It includes local and global citizenship (local and global), which is about understanding the roles and responsibilities of citizens living in democratic societies nationally and internationally, demonstrating solidarity by taking part in solving problems locally and globally, and showing respect for cultural differences. Life and career skills focus on the ability to adjust to change, demonstrate flexibility in interacting with others, manage goals and time and projects, work in a self-oriented way, and interact effectively with others in diverse groups and various roles. Personal and social responsibility involves demonstrating ethical behaviour, integrity, and social responsibility, including cultural awareness and competence, as well as the ability to communicate constructively in diverse social situations.

Acquiring these 21st-century skills is essential for all learners, including those with disabilities, to navigate the complexities of modern life, work effectively in diverse teams, and adapt to new challenges. By integrating these skills into learner-centred and inclusive education practices and providing appropriate support and accommodations, educators can empower all learners to reach their full potential and contribute meaningfully to society.

Phenomenon-based learning as a modern pedagogical approach

Traditional vs. modern pedagogy

Over the past two decades, a transition has occurred from traditional pedagogy to modern pedagogical approaches. This has brought a significant shift in educational philosophy and practice. While traditional pedagogy focuses on transmitting knowledge through structured lessons and teacher-led direct instruction, modern pedagogical approaches, such as PhBL, emphasise student-centred, experiential, inquiry-driven and competency-based approaches that centre around real-world phenomena.

	Traditional pedagogical approaches	***Modern pedagogical approaches e.g. PhBL***
Definition	• A teacher-focused method that emphasises the delivery of knowledge and learners' passive reception	• A learner-focused method that highlights active involvement, personalized learning, and practical application.
Characteristics	• Teacher-led • Knowledge transfer from the teacher to learners • Passive student role • rote memorisation • Teacher assessments	• Learner-centred • Active engagement • Customised learning • Practical application • Collaboration and interaction
Advantages	• Well-structured and organized • Clear expectations	• Boosts interest and intrinsic motivation

	• Effective for large groups • Comparability of learning outcomes across schools and regions • Efficient in delivering large volumes of information	• Fosters creativity and critical thinking • Addresses individual needs • Enhances practical skills • Encourages collaboration
Disadvantages	• Low learner engagement • Lack of personalization in learning • Dependence on external rewards • Limited practical application in real-world contexts • Minimal collaboration and interaction between learners	• Requires teacher training • Needs additional resources and technology • Can be challenging to implement uniformly

Adapted and enhanced based on (Yue, 2024)

Traditional and innovative learning models differ in their approach to:

- learning /teacher-centred or student-centred approach/;
- teaching styles;
- the degree of personalization of training;
- learning styles;
- the digital and smart-digital technologies used.

Traditional and innovative learning models have many differences but also share some similar characteristics.

Similarities between traditional and innovative learning models

- **Aim to acquire knowledge** and forming skills / both types of models strive for quality education with effective acquisition of knowledge and formation of skills.
- **Use of learning materials** - textbooks, teaching aids, study notebooks /including digital/, lectures and discussions are inherent to both traditional and innovative learning models.
- **Leadership role of the teacher** – regardless of the model, the teacher remains the key to the learning process.
- **Multidimensional roles of the teacher**: in both traditional and innovative learning models, the teacher performs multidimensional roles, presented in Figure 1.

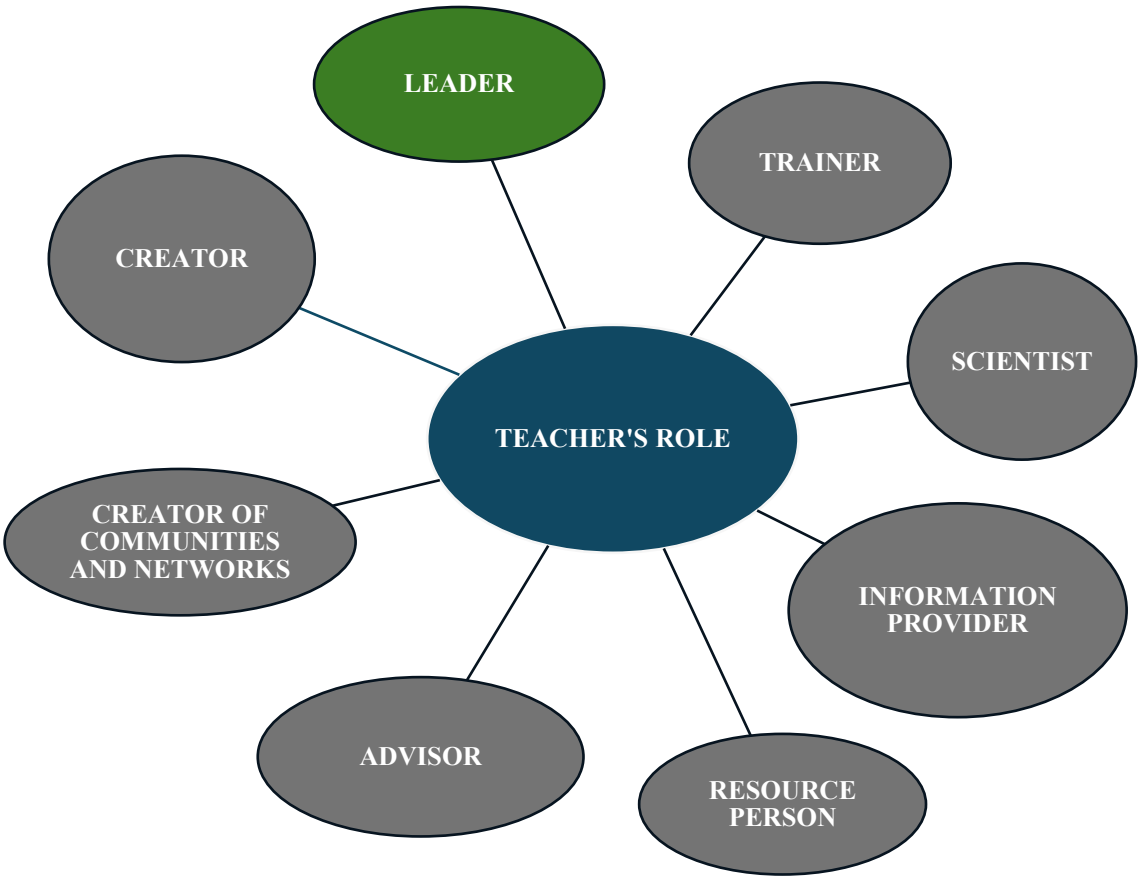


Figure 1. Teachers' characteristics

The teacher as a classroom leader has the responsibilities outlined in Figure 2.

Figure 2. Teachers' responsibilities

Differences between traditional and innovative models

Table 1.

Traditional learning models	Innovative learning models
Fixed curriculum	Flexible and adaptive learning paths
Passive listening to the lesson by students	Active student participation through interactive methods
Teacher-student interaction	Team interactions: teacher-student-student
Standard tests and exams	Adaptive testing and dynamic feedback
Textbooks and written materials	Digital resources, digital technologies

Traditional learning models	Innovative learning models
A universal approach for all students	Personalized training according to individual needs
Limited technology integration	Using artificial intelligence, virtual classrooms and mobile applications
Formal assessment by the teacher	Formative assessment by the teacher, peer assessment and self-assessment

Key advantages of innovative models

- Increased student engagement through interactive methods;
- Better adaptation to individual needs;
- Expanded online and hybrid learning options;
- Using artificial intelligence to analyse progress.

Traditional learning models have been used since the dawn of education. Undoubtedly, education is also undergoing transformations and is evolving with the development and implementation of innovative teaching methods that transform learning into **a more engaging, personalized, and effective process**.

Innovative learning models

INNOVATION

The term innovation means "introducing novelties" or "making changes." Yet Zaltman & Lin (1971) derive three models for understanding "innovation":

- synonymous with invention, as the creation of a new entity through a creative process.
- a process in which an existing innovation is perceived by a person - it becomes a part of their knowledge and behaviour.

- a description of something that has been invented and is considered new, regardless of whether it is perceived as the introduction and dissemination of that new thing."
- European Commission on Education (Decision No 1350/2008/EC of the European Parliament and of the Council of Europe 2009) provides definitions of creativity and innovations:
- creativity - an activity of the imagination aimed at achieving results that are both original and valuable;
- innovation - a new or proven significant product (item or service) or process, new marketing method or new organizational method, business practice, workplace organization or external relations. (https://eur-lex.europa.eu/legal-content/BG/TXT/PDF/?uri=CELEX:32008D1350&from=ES).

Innovation is defined as "the effort to create a deliberate, focused change in the economic or social potential of an enterprise" (Drucker, 2013). In other words, innovation is change to create better results.

Innovation is based on invention, but innovation and invention are not the same thing (https://morethandigital.info/bg/inovaci-opredelenie-vidove-i-znachenie/).

"An **invention** is the creation of something that has not existed before, born from research, experiment and imagination. It is the first step in creating a new idea, device or method and often acts as a catalyst for future developments. Inventions lay the foundations of progress in various fields by providing new solutions or opening up new paths for research and development.

Innovation, on the other hand, goes beyond the act of invention by applying these new or improved ideas, processes, or products in a way that has an impact on the society or the markets. It involves turning an invention into something that adds value or meets the needs of consumers in a new and effective way." (https://morethandigital.info/bg/inovaci-opredelenie-vidove-i-znachenie/).

Innovation is defined as an interactive process of transforming opportunities into practical uses of interaction (Freeman, 1987; Kline & Rosenberg, 1986; Tidd, Bessant, & Pavitt, 1997).

In this context, Chin (1963) characterizes education innovations as involving substitution (e.g., one textbook for another); alteration (e.g., a minor change such as lengthening the school day by a few minutes); perturbation (e.g., moving a class to a mobile classroom); restructuring (e.g., adopting team teaching); and value orientation (e.g., replacing the teacher by self-administered simulation games).

Innovation and innovative school culture

"Innovative changes in education have their own parameters according to:

- the pace of change;
- the goal being pursued;
- the feelings they evoke;
- the source of changes;
- the volume and field of action;
- the degree of consideration and planning of the idea" (Totseva, 2012).

The implementation of innovative learning models creates an innovative school culture. According to Denison & Spreitzer (1991) ; McDermott & Stock, (1999); Škerlavaj, et al., (2010), four main components of an innovative school culture can be identified , presented in Figure 3.

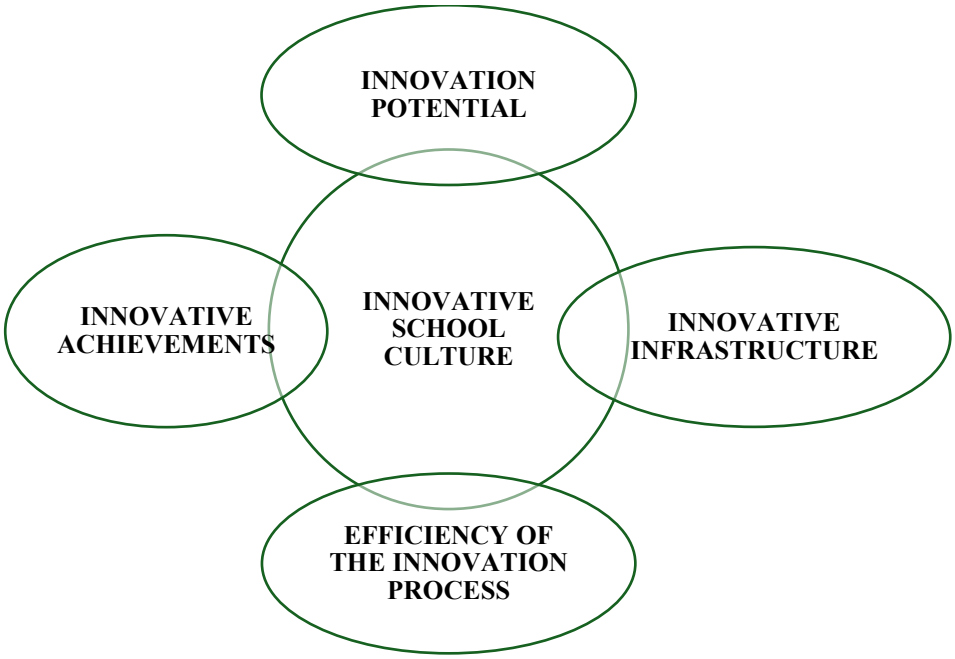


Figure 3. Components of the innovative school culture

The specifics of the four components of innovative school culture can be found in the following explanatory models (after Denison & Spreitzer 1991 ; McDermott & Stock, 1999 ; Škerlavaj, et al. , 2010):

✓ ***Innovation potential*** of the educational institution is associated with recognizing the right course for development in the future and new trends in the development of education and the sensitivity of pedagogical specialists to innovations. Teams of motivated pedagogical specialists are created. The innovative potential depends on the image and reputation of the institution in the community, and the support from public organizations and the parent community.

✓ ***Innovation infrastructure*** implies the presence of a "knowledge infrastructure", which includes the structural facilities aimed at generating and disseminating knowledge. The introduction of ICT in education enriches the use of innovative online educational tools, and creates opportunities for teachers and students to create their own personal educational environment, to carry out the educational process almost entirely online, in a cooperative space.

✓ ***The effectiveness of the innovation process*** depends on a well-defined innovation strategy; the creation of teams that explore, generate, and implement new ideas, discuss various options for implementing ideas, experiment with new ideas, and apply them correctly; established leadership in the educational institution, etc.

✓ ***Innovative achievements.*** Innovative achievements include all activities and results of education, which are manifested in improved quality of education. The change has been accepted as a natural progression of trust and met expectations. Full employee commitment to innovation has been achieved through collaboration between multidisciplinary teams, which in most cases are self-organised and interdisciplinary. A positive, inspiring work atmosphere has been established, in which innovation stimulates active learning. Innovation in the organization is seen as a key factor for success. (according to Denison & Spreitzer, 1991 ; McDermott & Stock, 1999 ; Škerlavaj, et al. , 2010).

Types of innovative learning methods

Innovative learning methods include **interactive, technological and personalized approaches** that improve engagement and effectiveness of the learning process. Among the most recent innovative learning models can be mentioned:

1. **Interactive Learning:** The term 'interactive' appears in two distinct strands of educational research discourses: one refers to pedagogy and the other refers to new technologies in education. Teaching students with the traditional method, where there is only one way of communication, is no longer effective. The word 'interactive' is the key to an effective and efficient teaching and learning process, where the teacher can capture the attention of students and students can learn more compared to the traditional method (Pradono et al., 2013). **Most often, interactive learning uses learning through games, group discussions, debates, etc.**

2. **Interdisciplinary learning** involves a method or sets of methods used to teach different academic disciplines or "unite separate disciplines around common themes, questions, or problems" (Ellis & Stuen, 1998). Often, interdisciplinary learning is associated with or is a component of other teaching approaches.

3. **Phenomenon-based learning** involves studying the curriculum content by topic or concept using a holistic approach instead of using a subject-based approach.

4. **Blended learning is a combination of online and face-to-face classes.** in a flexible learning process.

5. **Flipped learning, or more popularly known as a flipped classroom, is a method in which** students study the material independently and focus on practical application in class.

6. **Project-based learning, in which real-life cases and practical tasks are solved mainly** through the implementation of projects related to a real-life and/or professional environment.

7. **Collaborative learning involves** teamwork and sharing of knowledge and skills among students.

8. **Teaching with mixed teaching** where two or more teachers in the classroom (co-teaching) are teaching and working together in the classroom, sharing responsibilities for planning, teaching, and assessing students**.**

9. **Learning by doing or experience**, provoking experiential learning, focusing on practical experience and the active participation of students who learn by doing.

10. **Social-emotional learning**, in which educators and students demonstrate not only cognitive, but also social, emotional, and behavioural engagement with the learning content.

11. **Teaching with digital and smart technologies** such as Open Educational Resources (OER), OOER (open online educational resources), MOOCs (massive open online courses), Smart Learning Educations (intelligent/smart learning environments), Digital Immersive Realities, Internet of Things, serious educational games, digital twins, artificial intelligence in education for creating personalized learning paths, mobile technologies, etc. (according to Levterova-Gadzhalova, 2024).

12. Microlearning **and modular learning, which includes short, targeted learning modules** with focused learning on specific topics and **personalized courses** where students choose content according to their interests.

Interactive learning

The term “interact” means a mutual or reciprocal action of two or more individuals with a certain effect on them. Interaction involves communication, cooperation, agreement or reciprocity in carrying out a given activity with a mutually satisfactory result from it. Interactive action is bidirectional (Pratt, 2003) or multidirectional (Paladini, Carvalho, 2008).

Interactive learning is an approach to education that places the student at the centre of the learning process and transforms him from a passive listener into an active participant. It is based on **interaction**, **collaboration**, and **practical application** of knowledge.

- Students actively participate through discussions, games, simulations, case studies, and projects.
- Students develop skills, not just acquire knowledge.
- The teacher is **a facilitator**, not just a source of information.
- An environment of cooperation, critical thinking, and personal development is created.
- **A technology**, visual materials, group work, and creative tasks are used.

Interactive methods

Interactive methods are “procedures, systematic ways, containing the sequence of joint actions of researchers to achieve a certain goal in a certain scientific field. These are the appropriate ways to carry out the activity related to solving a given problem. Interactive methods are based on social constructivism, according to which learning is the result of social communication in a certain context. Communication takes place between students in the work team, between students and the teacher, between students and external experts.” (http://honolulu.hawaii.edu/intranet/committees/FacDevCom/guidebk/teachtip/comteach.htm).

The most popular classifications for interactive methods divide them into several groups:

- **Imitative** – simulations, role-playing games, webinars;

- **Discussion** – debates, discussions, brainstorming, work on cases and real problems, discussion forums;
- **Diagnostic** – surveys, tests;
- **Creative** – brain mapping, drawing ideas, creating presentations and projects;
- **Games** – dramatizations, case studies, quizzes, virtual laboratories;
- ***Social-relational*** - work in pairs or small groups.

According to the classification of Popova et al. (2007), the types of interactive methods are:

• *Methods and techniques for collecting information* – pyramid, avalanche, idea recording, SWOT analysis, lightning, spin or circle, traffic light, split poster, card poll;

• *Methods and techniques for generating creative summarization of ideas* – brainstorming, essays, mind maps, drawing ideas; *Discussion methods* – discussion, panel discussion, case studies, debates, "aquarium", case studies, "ball bearing";

• *Game methods* – role-playing games, simulation games, situational games, dramatization games;

• *Methods and techniques for summarizing information* – the three most important things, split poster, poll with dots, "dissonance";

• *Methods for managing the learning process* – presentation, "mood barometer";

• *Methods used in vocational training* – imitation method, "five steps", learning task, method of the leading text, project method, "learning workshop". (Popova et al., 2007)

Advantages of interactive learning are:

- Increases student **motivation** and **engagement;**
- Develops **critical thinking**, **communication skills** and **teamwork;**
- Improves **understanding** and **memorization** of learning material;
- Encourages **independent thinking** and **solution-seeking.**

"The problems of the real world do not come in discipline-shaped boxes." — David Perkins (Harvard Graduate School of Education)

The holistic approach and the constructivist educational paradigm – the basic theoretical basis of interdisciplinary learning

In the 21st century, the humanity is constantly searching for new points of reference and perspectives for development that meet the modern requirements of the rapidly developing world. In this regard, there is a clear preference for applying a holistic approach in various sciences as a philosophy and methodology that views phenomena, systems, and humans as unified, indivisible, and interconnected wholes, rather than simply as a collection of separate parts.

The holistic approach is based on several key principles:

- **Holistic approach –** the individual or system is considered in its completeness – physically, emotionally, mentally, socially, and spiritually.
- **Interconnectedness –** all elements in a given system (e.g., person, family, society) interact and influence each other.
- **Individuality** – each person is unique and there is no universal solution that is effective for everyone.
- **Prevention** – the emphasis is on prevention and maintaining balance, not just on correcting problems.

In the context of education, the holistic approach considers the student not only as a "learner" (receiving knowledge), but as a complete person with emotions, social needs and individual potential. Teaching, in turn, does not mean only "transmitting knowledge", but also includes social-emotional learning, motor activity, arts, critical thinking, etc., while promoting a connection with nature and sustainable habits.

The advantages of the holistic approach are:

- ✓ Deeper understanding of the issues.
- ✓ Searching for sustainable and comprehensive solutions.
- ✓ Improving quality of life.
- ✓ Opportunities for interdisciplinary work.

There is a strong and multi-layered **relationship between the holistic approach and the constructivist educational paradigm.** They are compatible and mutually enriching.

While constructivism emphasizes **how the student learns** (actively, socially, through experience), the holistic approach complements who **the student is** – as a person with values, needs, emotions and goals. Both philosophies focus on the student as an active, whole and unique subject, rather than a passive recipient of knowledge. Although they originate from different theoretical foundations, they complete each other in their desire to place the person at the centre of learning. Theoretically, the holistic approach is associated with humanistic psychology (Carl Rogers, Abraham Maslow) – where learning is a process of self-actualization. Constructivism, on the other hand, has its roots in the works of Jean Piaget, Lev Vygotsky, John Dewey – who believe that knowledge is constructed through an active dialogue between the individual and the world. However, both concepts offer an alternative to traditional, frontal teaching and strive to meet the complex needs of students in the context of the 21st century. Their combination creates conditions for more meaningful, engaging and sustainable learning.

There are several arguments for this:

- **Both philosophies recognize the personality of the student**

The holistic approach considers the personality in all its aspects – intellectual, emotional, social and spiritual. Therefore, J. P. Miller – a prominent supporter of holism claims: “Holistic education seeks to nurture the development of the whole person” (Miller, 2007). This approach aims not only to accumulate knowledge, but to create conditions for a fulfilling life and inner affinity. Constructivism assumes that knowledge is actively constructed by the student based on his own experience. As Jean Piaget emphasizes: “Knowledge is not a copy of reality. To know an object is to act on it”. (Piaget, 1970). In this way, learning becomes a personal and meaningful experience.

- ***Both approaches emphasize active participation in learning***

Holistic education encourages exploration, experience and reflection – processes that are also at the heart of constructivist learning. A vivid example of this is the views of L. Vygotsky, who emphasizes the importance of the social context and support in learning, pointing out that "what the child does today with help, tomorrow can do independently" (Vygotsky, 1978). This is in full harmony with the holistic aspiration to develop the potential through relationships and a supportive environment.

- **Both paradigms view education as a process related to life, not as preparation for it**

As early as 1938, John Dewey, in "Experience and Education", argue that education is not preparation for life, but the life itself. This understanding is directly linked to the holistic vision of education, which integrates academic knowledge with personal and emotional development.

In summary, it can be said that the holistic approach and the constructivist educational paradigm are based on similar values and goals. Combining them helps to create an educational environment that reflects the real needs of students and supports them in developing self-awareness, critical thinking, and interpersonal sensitivity. In such an education lies the potential to create conscious, responsible, and compassionate individuals, which our contemporary world clearly needs.

In seeking the applicability of the analysed approaches in the educational practice, it should be said that the teacher, guided by holistic-constructivist principles, can act in the following directions in the classroom:

- ✓ To monitor and support each student's individual progress – not only academically, but also emotionally.
- ✓ To create authentic learning situations based on real problems.
- ✓ To stimulate collaboration, sharing of perspectives, research, experimentation.
- ✓ To provide freedom of choice – for students to participate in the "creation" of the learning process.
- ✓ Use integrated lessons – including science, arts, and social skills, etc.

Monodisciplinarity vs. interdisciplinarity

The topics of monodisciplinarity and interdisciplinarity have emerged as a key one in contemporary discussions and understandings of studying, teaching, and learning, especially in the context of the changing educational paradigm of the 21st century.

Monodisciplinarity has been classic in education for millennia, viewing learning as organizing and teaching knowledge within a single academic discipline (e.g. only mathematics, only history, etc.), without significant direct connection and interaction with other subject areas. In its application, the learning content is structured in a single academic subject, taught by a specific specialist in the discipline, and students are expected to acquire in-depth basic knowledge within the specific scientific field. Its importance for learning is expressed primarily in the presence of in-depth expertise and the development of students' logical thinking. Its main negatives are the lack of connection with real-life contexts, the separation of knowledge into separate, highly fragmented categories, and the reduction of motivation for learning, especially in students with interests beyond the specific academic discipline.

In its turn, the interdisciplinarity in education is generally accepted as an approach that integrates knowledge, skills, and methods from two or more disciplines in order to achieve a more complete understanding of a given problem or phenomenon. Its essence and characteristics are expressed in the creation of thematic modules or projects that combine several school subjects. Teaching is carried out by teachers of different subjects who collaborate, and students should acquire and apply knowledge from different areas in real or simulated situations. The following are the positive aspects of its application: the development of critical and systematic thinking; increasing motivation to learn by connecting it to the real world and stimulating creativity, cooperation, and flexibility in learners. Its significance for learning is expressed primarily in the presence of connected knowledge, creativity, adaptability, and real skills. The negatives of interdisciplinarity are outlined in the following areas: it requires more time and resources for planning; it can lead to "shallow" knowledge if not well balanced; it requires additional qualifications and readiness on the part of teachers to work together.

The comparative analysis of monodisciplinarity and interdisciplinarity is visible in the following comparative table:

Table 2.

Criteria	Monodisciplinarity	Interdisciplinarity
Definition	Training is focused on only one academic discipline.	Integrates knowledge and skills from two or more disciplines.
Focus	Deepening knowledge within a subject.	Solving real problems by combining different perspectives.
Examples	Private lesson in math, history or chemistry.	Sustainable Food Project (Science, Geography, Ethics, Technology).
Learning type	Analytical, linear	Connected, comprehensive, contextual
Role of the teacher	Content expert	Facilitator working in a team with other teachers.
Role of the student	Passive or individual participant	Active participant, collaborates and thinks critically
Approach to knowledge	Isolated concepts and skills	Related and contextual knowledge
Student motivation	Lower, especially if there is lack of interest in the subject	Higher, thanks to the connection to the real world
Planning	Easier to implement and coordinate	More complex – requires collaboration between teachers
Skills acquired	Disciplinary skills and knowledge	Creativity, collaboration, critical thinking, systemic perspective

In summary, its main importance and advantages are expressed in the following:

- Supports critical and systematic thinking;

- Encourages creativity;
- Facilitates the transfer of knowledge between contexts;
- Prepares students for the complex world of the 21st century.

Interdisciplinarity itself is often presented as an innovative approach, but in fact it has deep philosophical and epistemological roots. It emerged and developed as a reaction against the excessive fragmentation of knowledge into separate disciplines and strives for a more comprehensive understanding of complex phenomena. Its origins in historical terms can be found in ancient philosophy - in the views of Plato and Aristotle, who viewed knowledge as a single system in which the different fields of knowledge are connected. Later, during the Enlightenment, the ideals of universal knowledge and reason were added, encouraging the combination of science and the arts, and in the 19th century, Wilhelm von Humboldt pioneered an integrated approach to higher education, combining scientific research and teaching. Interdisciplinarity in contemporary education is associated with the 20th century and progressive education and the views of John Dewey: to promote learning based on experience and the connection between knowledge and real life, leading to the integration of different disciplines. After World War II, the growing complexity of global issues (e.g., ecology, urbanization, technology) gave rise to the need for complex approaches to knowledge—a stimulus for interdisciplinary education.

The historical development of interdisciplinarity in education can be briefly traced in the following Table 3.

Table 3.

Period / Stage	Key ideas and characteristics	Key figures
Antiquity	Knowledge is perceived as a unity between philosophy, science, and arts; a harmony of mind and spirit.	Plato, Aristotle

Period / Stage	Key ideas and characteristics	Key figures
Middle Ages	Scholastic system, division between "secular" and "divine" knowledge, but attempts at unification through "trivium" and "quadrivium".	Aurelius Augustine, Thomas Aquinas
Renaissance	Revival of interest in holistic knowledge – art, science, literature in synthesis.	Leonardo da Vinci
Enlightenment (XVII-XVIII centuries)	Belief in reason and universal knowledge; the beginning of the systematization of disciplines.	Descartes, Leibniz, Kant
19th century – University model	Scientific specialization, but combined with the idea of a holistic education.	Wilhelm von Humboldt
Early 20th century	Progressive education, connecting knowledge with life and practice.	John Dewey, Maria Montessori
After World War II	Emergence of systems theory, cybernetics; need for complex analysis of global problems.	L. von Bertalanffy, Norbert Wiener
1960–1980 – Academic upsurge	First interdisciplinary programs in universities; cultural and social movements promote integrative thinking.	J. Piaget, J. Bruner, J. Delors
Late stage - 20th – 21st century	Constructivism, project-based and problem-based learning; STEM/STEAM approaches.	Vygotsky, Alan Repko, Julie T. Klein

Interdisciplinarity in educational practice today is most often applied in the following dimensions:

- Creating integrated curricula (e.g. STEM – science, technology, engineering and mathematics).
- Implementation of problem-based learning (PBL), requiring the use of knowledge from multiple academic fields to solve real-world problems.

- Organizing project-based learning, which often combines subjects such as history, literature, science, technology and arts, etc.

The relationships between interdisciplinarity, multidisciplinarity and transdisciplinarity

The relationships between interdisciplinarity, multidisciplinarity, and transdisciplinarity have been interpreted in various ways in several scientific publications on this topic. In Bulgaria, too, quite a few authors have interpreted this topic. Over the past three to four years, Natalia Vitanova has conducted an in-depth and extensive analysis of the problem of the dimensions of interdisciplinarity in education, as well as of the concepts, in her publication "Interdisciplinarity in the educational process." The author points out that "interdisciplinarity is cooperation between and integration of knowledge from different disciplines to achieve shared goals and products." "It is called multidisciplinarity when there is less interaction and integration of knowledge and if the common problem is simpler than in interdisciplinarity, and it is called transdisciplinarity when there is more interaction and if the common problem is more complex than in interdisciplinarity (Vitanova, 2023). Revealing interdisciplinarity as a multifaceted concept and depending on the goals pursued, Vitanova examines four dimensions of this concept, citing (Lenoir, Hasni, 2016): academic, school, professional, and practical interdisciplinarity. In the context of school interdisciplinarity, Yves Lenoir and Abdelkrim Hasni note that it "aims to teach academic knowledge and educate: by creating the most appropriate conditions for initiating and maintaining the development of integrative processes by students and their acquisition of knowledge as cognitive products, which requires the organisation of school knowledge into a curriculum, learning theory and teaching strategies. It is based on the concept of teaching and learning (training) – it accepts the school subject as its reference point. It refers to a given discipline as a school subject (school knowledge) and therefore a reference system that is not limited to the sciences but includes various components (pedagogical, moral, political, cultural, economic, etc.). It leads to the creation of complementary links between school disciplines." (Lenoir and Hasni, 2016).

How to make interdisciplinary learning a reality?

It is a fact that being in school allows students to develop different ways of understanding the world around them. But it is also a fact that the world is not divided into small disciplinary frames in the way that schools typically structure academic subjects into separate classes.

For school interdisciplinarity to be practically useful, some recommendations that have proven their productivity can be offered:

There are three key things (rules of interdisciplinarity) that teachers should keep in mind when planning interdisciplinary lessons.

1. Search for overlaps in curricula

The curriculum requirements of a given subject are one of the biggest obstacles to cross-curricular coordination and are often beyond the control of teachers. In practice, most teachers cannot simply develop a one-month module for interdisciplinary learning. Therefore, it is a good idea to experiment with so-called micro-units – a series of three to five lessons for integrated learning. At the beginning of the school year, natural areas of overlap (in content or skills) across individual subjects can be sought and shared with colleagues teaching these subjects. On this basis, interdisciplinary lessons are planned and organized over several days. The number of teachers in the team can vary, so it is important to determine what is reasonable and feasible.

2. Choosing a topic and criteria for summative assessment

Although natural overlaps in curricula may lead to the choice of topic(s), it is also a good idea to consider student interests or contemporary issues that can be used to target a shared skill across grades. Once the topic has been decided, the first major step in planning is to define the criteria for a summative assessment that is valid for all students in the interdisciplinary lesson from the participating grades.

It is a good idea to create a set of discussion questions that students can answer in writing using different structures (statement, evidence, reasoning, etc.). This allows for a more objective assessment of the knowledge and skills acquired by them. If the questions are formulated to be broad and comprehensive, they allow students to integrate and apply

knowledge from different academic disciplines. Sufficient time and resources should be provided to help students prepare for the final discussion.

3. Knowledge building and research for each discipline

Considering the shared summative assessment, basic knowledge and engagement with research for each of the included disciplines should be provided. From a logistical point of view, the teaching of this basic knowledge takes place in monodisciplinary teaching in each subject, but with a coordinated approach by the participating teachers (through shared lesson plans). Each teacher is responsible for selecting subject-specific resources related to the topic, planning individual classes, and conducting formative assessment.

Through the proposed three-step algorithm, one of the biggest obstacles to achieving true interdisciplinary teaching in the educational environment—the need for constructive collaboration between teachers—can be overcome. This may be difficult to achieve, but it is not impossible. Interdisciplinary teaching and learning are maximized when professionals from different disciplines work together to serve a common goal and help the students make connections between different disciplines or subject areas. Such interaction supports the constructivist paradigm, which allows for the construction of new knowledge and a deeper understanding of ideas than disciplinary teaching.

Interdisciplinary learning provides a chance to synthesize ideas and synthesize characteristics from many academic disciplines. At the same time, it addresses individual differences among students and helps develop important, transferable skills. These skills, such as critical thinking, communication, and analysis, are important and constantly evolving at all stages of life. Education systems serve students best when they empower and encourage them to build their own interdisciplinary path. This approach will certainly encourage a love of learning, spark enthusiasm, and address differences in student learning.

Source by: https://www.maine.gov/doe/learning/II

Problem-based learning

Problem-based learning is any learning environment in which a given problem leads to learning. The problem creates conditions for learning new knowledge before the problem is solved.

Problem-based learning:

- is a method that challenges learners to learn through solving problems presented in the form of case studies and simulations;
- allows learners to be self-directed and acquire lifelong learning skills;
- develops critical and creative thinking;
- integrates knowledge and skills from different academic disciplines;
- motivates learners to find and use appropriate learning resources;

- presents experiential learning.

TYPES OF PROBLEM-BASED LEARNING:

- traditional problem-based learning;
- project-based learning;
- problem-based learning with simulations;
- case-based learning.

CHARACTERISTICS OF PROBLEM-BASED LEARNING:

- **Authentic Problems**: Presents students with *real-world problems or challenge*, making the learning experience more relevant and practical.
- **Active learning: Instead of passively listening or memorizing, students** *actively* engage *with the problem*, which encourages critical thinking and problem-solving skills.
- **Self-Directed Learning**: Encourages *self-directed learning*, where students take responsibility for their own learning process.
- **Collaboration**: Students typically work in small groups, encouraging *collaboration, communication, and teamwork skills* as they discuss and develop solutions together.
- **Interdisciplinary approach**: Often encourages *interdisciplinary thinking*.
- Solves real-world problems that do not have one "right" answer;
- Teachers act as facilitators;
- It deals with a specific problem while requiring knowledge and skills from several disciplines;
- It is usually shorter than project-based learning and follows specific, traditionally prescribed steps;
- The result is a proposed solution, expressed in writing or in an oral presentation.

SEVEN STEPS OF THE PROBLEM-BASED LEARNING PROCESS:

- Identifying, clarifying terms in the script.
- Defining the problem
- Brainstorming
- Reframing the problem
- Definition of learning goals/objectives.
- Independent study
- Regrouping/Synthesis

The life cycle of problem-based learning is presented in the following figure 4.

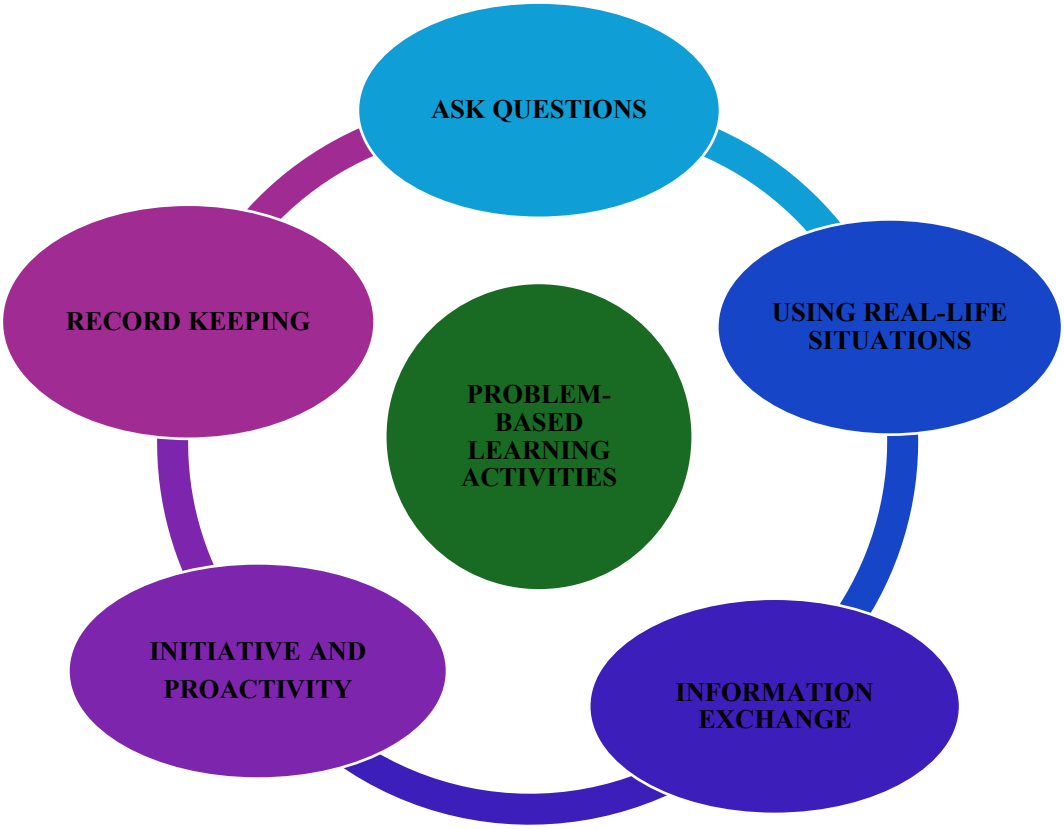


Figure 4. The life cycle of problem-based learning

ADVANTAGES OF PROBLEM-BASED LEARNING:

- Stimulates the active participation of students in their learning.

- It helps to better remember information because it connects it to real situations.
- Develops skills for applying knowledge, solving problems, and self-directing learning.
- Appreciates the importance of the material taught and connects it to practice.
- Fosters a sense of community between students and teachers.

CHALLENGES OF PROBLEM-BASED LEARNING:

- It requires more time, resources, and preparation from teachers and students.
- It can lead to cognitive overload for students if the problems are too complex or unclear.
- It can create conflict or inequality in group work if students are not well organized or do not share common goals.
- It may miss important aspects of the curriculum if the problems are not well chosen or do not cover all topics.
- May face resistance or distrust from parents, administrators, or other educators who do not understand or support this method

Project-based training

The modern model of project-based learning, also called the project method, was developed by the Buck Institute of Education (USA) in the late 1990's in response to school reform efforts. Project-based learning is defined as "an instructional method that presents students with complex tasks based on challenging questions or problems that involve problem solving, decision-making, research skills, and self-reflection that involve teacher facilitation but not direction."

The project method is an approach to work and training in which learners are encouraged to make connections between learning material and reality, looking for parallels between things and events, as well as to adapt to work together with others to solve the main problem.

Unlike traditional learning, proponents of the project method strive to give the learner the freedom to solve problems. The teacher is seen more as a facilitator than as a sole provider of knowledge and information.

In the project method, the learning process provides conditions for students to create products themselves and gain experience in creative research activities. It is defined as a system of views in which students gain knowledge in the process of planning and implementing successively more complex practical tasks called "projects".

Project-based learning includes: problematization of the learning material; cognitive activity and practical-oriented activities for children; linking learning with play, work (labor), and the child's life; design and reflection. In this approach, the learning process is based on cooperation, which creates conditions for active joint learning activities and opportunities for individualization and differentiation.

Project-based learning or the project method is defined as:

- Method of cognition, a way of organizing students' educational and cognitive activities – a way of achieving didactic goals through detailed development of the problem (technology), which must be completed in full, necessarily with a practical result, formed in one form or another (research or a real object).
- A new pedagogical technology that can solve many current tasks in the course of student education – a person-oriented technology, a way of organizing students' independent activity, aimed at solving tasks within the framework of the educational project, integrating the problem approach, group methods, reflective, presentational, research, etc.

PRINCIPLES OF PROJECT-BASED LEARNING

- Principle of expediency;
- Principle of usefulness;

- Principle of freedom - The topic of the project can be freely chosen by the students depending on their interests, and the teacher only guides them, helps them and evaluates the final product;
- Action principle - The project should enable learners to learn through action. It should contain practical activities;
- Principle of reality - The project should not deal with imaginary situations, but rather be related to real-world issues;
- Principle of social development - A good project must consider the needs and problems of society and in some way benefit them;
- Planning principle - Before starting work, learners should think about solutions to some questions such as: - How? When? What? Where? Why?

TYPES OF PROJECTS

- constructive project – practical activities such as acting out a dramatic scenario, creating a model;
- aesthetic project – includes musical and poetic programs;
- problematic project – solving problems using the experience of real life;
- training project – exercises the efficiency and abilities of the trainees;
- individual and social (group) projects;
- simple and complex project.

ADVANTAGES OF PROJECT-BASED LEARNING

- The trainees participate in active and purposeful activities, providing them with the opportunity to:

- Freely choose a topic they are interested in;
- To gain real experience by engaging in practical activities;
- To experience enthusiasm and satisfaction from being involved in such an activity;
- To study and create ideas

- Trainees develop independent thinking and a creative approach to work through:

- Self-evaluation of their own work (analysis of possible errors);

- Learning to complete their work and draw conclusions;

- Showing initiative, ingenuity, resourcefulness.

- Trainees develop communication skills as well as collaboration skills:

- They work in groups and teams;

- A wider area is created in which information is provided;

- Learners learn to express their opinions (self-regulation, tolerance, critical thinking) during discussions.

- Trainees learn to support others and seek help themselves.

- The method allows for the development and deepening of knowledge and awareness, skills and competencies:

- Students learn to use additional literature;

- They learn to systematize and summarize the acquired theoretical knowledge, applying it in practice;

- To work as a team and cooperate with each other;

- To identify, analyse and solve problems.

- Students work in groups
- Trainees acquire additional knowledge, skills, competencies, diverse experience
- The project method develops critical and creative thinking
    - Analysing problems
    - Searching for unusual and original ways to solve problems
    - Discussion
    - Raising questions
    - Searching for cause-and-effect relationships
- Trainees improve their communication skills and acquire new personal skills:

- independent approach

- creativity

- friendly relations

- intellectual curiosity

- independence
- tolerance
- social skills
- individuality
- responsibility

CHALLENGES FOR PROJECT-BASED LEARNING

- the selection or construction of situations that provide the possibility of good projects;
- structuring problems as learning opportunities;
- collaborating with colleagues to develop interdisciplinary projects;
- dynamic management of the learning process and self-study;
- integrating technologies where appropriate;
- helping students give authentic assessments;
- time consuming.
- Difficult to find sufficient financial resources to ensure a sufficiently high level and quality of the project.
- The project can only be successful if it is led by an erudite teacher who will have many diverse responsibilities.

COMPARATIVE ANALYSIS OF PROBLEM-BASED AND PROJECT-BASED LEARNING

Table 4.

Problem-based learning	**Project-based training**
Develops creative thinking	Develops creative thinking
Encourages independent learning	Teach to project management
Improves teamwork skills	Improves teamwork skills
Real-world oriented	Focuses on practical application

Develops multidisciplinary skills	Develops multidisciplinary skills
It begins with a specific problem that students must analyse and solve using research skills.	Involves the creation of a product or complete project that demonstrates what has been learned through practical applications.
Emphasizes critical thinking and problem solving through discussions and analysis of real-life situations.	Action-oriented and focused on project completion, which requires planning, cooperation, and long-term work.
The result is usually a solution or conclusion to a problem.	The result is a physical or digital product—for example, a presentation, model, report, or software.
More flexible and may not have a predefined end result.	Has a clearly defined end product and usually follows a specific schedule and process.

Co-teaching

Collaborative teaching (or co-teaching) is a strategy in which two or more teachers work together in one classroom to plan, teach, and assess student learning. "Co-teaching allows teachers to create an excellent, joyful classroom community where adults can teach and students can learn in the best possible way." (Murdock, Finneran, & Theve, 2015).

According to Cook & Cook's (2004) model, six models of collaborative teaching are distinguished:

- ✓ ***One teacher teaches, one teacher observes (One Teach, One Observe)*** *:*
  - **Description**: One teacher leads the lesson, while the other observes students, collects data, or monitors for specific behaviours.
  - **Advantages**: Suitable for diagnosis and assessment.

- **Challenges**: Can be perceived as an unequal participation

✓ ***One teacher teaches, one teacher assists:***

- **Description**: One teacher teaches, while the other supports students individually or in small groups.
- **Advantages**: Provides support to students with needs.
- **Challenges**: Risk of the second teacher being perceived more as an assistant rather than an equal partner.

✓ ***Parallel teaching***

- **Description**: The class is divided into two equal groups. Each teacher teaches the same topic at the same time.
- **Advantages**: Reduces the number of students per teacher, allows more interaction.
- **Challenges**: Requires timing and equal skills.

✓ ***Team teaching***

- **Description**: Both teachers teach simultaneously, complementing each other, leading discussions, or presenting different perspectives.
- **Advantages**: High level of collaboration, dynamic learning.
- **Challenges**: Requires excellent coordination and trust.

✓ ***Rotational teaching (Station teaching)***

- **Description**: Teachers divide the class into groups and create learning stations. Each teacher leads one station and students take turns.
- **Advantages**: Active student participation, differentiated learning.
- **Challenges**: Requires good organization and space.

✓ ***Additional teaching.***

• **Description**: One teacher works with the entire class, and the other teacher works with one child in another room /most often this is a resource teacher who works in the resource room with the student/.

• **Advantages**: Active participation of students in the classroom, additional and differentiated learning for the student in the separate office.

• **Challenges**: Requires good organization and a separate office from the classroom.

To the mentioned models from Cook & Cook (2004) can also be added:

✓ ***Alternative /differentiated/ teaching/ (Alternative Teaching)***

- **Description**: One teacher works with the larger group, and the other with a small group of students who need additional support.
- **Advantages**: Personalized training.
- **Challenges**: Can create a sense of isolation for students in the small group.

In the process of co-teaching, each teacher has an equal participation in the learning process. There is no more significant teacher, first or lead teacher. The roles are equal and equally responsible.

Collaborative teaching has a defined implementation cycle that includes collaborative planning, collaborative teaching, collaborative reflection, and collaborative debriefing. "The collaborative teaching cycle is the most powerful way to improve teaching practice. It encourages professionals to make their practices transparent and public, to become increasingly skilled, reflective, and develop a growth mindset" (Sharratt & Fullan, 2012).

Advantages of the co-teaching model:

- **Individual instruction.** Students receive more attention and support, especially students with special educational needs or low academic achievement.
- **Diverse teaching styles.** Combining different styles, approaches, and perspectives of teachers makes learning more dynamic (Bacharach, Heck, Dahlberg, 2010).
- **Promoting professional partnerships.** Teachers learn from each other by exchanging experiences and improving their practices.
- **Increased student engagement. Students working in smaller groups and participating in more diverse activities encourages active participation, engagement, and academic success**.
- **Inclusive environment**. Support for students with learning disabilities in the general education classroom is undeniable.
- Voluntary participation of teachers in co-teaching.
- Establishing effective communication with the co-teacher.
- Defining roles and effectively distributing responsibilities in collaborative educational activities (Austin, 2001).
- Building a successful pedagogical community (Rice, Zigmond, 1999).
- Effective collaborative classroom management.
- Shared responsibilities of teachers (Kohler-Evans, 2006);
- Joint implementation of timely feedback.
- Collaborative assessment of student achievement (Friend, Cook, Hurley-Chamberlain, Shamberger, 2010).

Challenges of the co-teaching model:

- **Lack of time for collaborative planning.** Teachers often do not have enough time for coordination and preparation.

- **Problems in building team relationships and distributing roles**. Sometimes one teacher is wrongly perceived as the "main" teacher and the other teacher as an assistant.
- **Differences in styles and educational philosophies.** Inconsistencies or even contradictions in teachers' approaches can lead to strain in relationships.
- **Insufficient leadership support.** Without clearly assigned responsibilities and institutional support, co-teaching can fail.
- **Assessment challenges**. Sometimes there are difficulties in tracking the individual student progress.
- ***Problems with prosocial behaviour*.** Difficulty presenting and accepting opinions, considering and accepting others' positions, and defending ones' own position.
- ***Problems in forming a team of teachers teaching in different subject areas***. There are difficulties in the joint work of teaching specialists in different subjects/fields.
- Conducting joint pedagogical situations/lessons, which are often distorted into a model where each teacher teaches their own subject sequentially, rather than in an interdisciplinary manner.
- Problems in discussing and planning specific measures for the progress of children/students.
- Problems with constructive conflict resolution.
- Problems with reflection on individual growth and contribution to the team.
- Problems with effective listening, effective work, and time management.
- Problems in developing effective procedures for team functioning and common solutions.

Current trends in co-teaching model:

- Using digital **technologies** for collaborative planning and teaching.

- Incorporating co-teaching into **cross-curricular projects** and in phenomenological education.
- Application of co-teaching in the implementation of STEM, **STEAM, STREAM approaches.**
- Formation of **teaching teams** that work on topics such as digital literacy, digital competencies, green competencies, sustainability, civic education.

Learning by doing

Learning by doing is an educational approach in which people acquire knowledge and skills through direct, practical experience, rather than through passive learning.

It is also referred to as ***experiential education***.

Learning by doing is also known as learning by practice and learning by experience. This educational model is effective because students master skills and learn from their mistakes and successes.

Main features:

- Learning in real conditions, on the move, challenging activities in nature.
- Active participation: Learners engage in real or simulated tasks.
- Trial and error: Mistakes are part of the learning process.
- Acquiring knowledge through personal experience.
- Meeting specific personal needs.
- Boosting motivation.
- Increasing self-confidence.
- Group interaction in which feedback, confrontation, and encouragement are invariably present.
- Reflection: Learners consider what had worked, what didn't, and why.
- Contextual learning: Knowledge is acquired in appropriate, meaningful settings.

Learning by doing is based on experimentation and the development of skills that are related to solving real problems, dealing with real conventional and extreme situations, and real life.

Learning by doing is a predictor of learning through experiences, whether positive or negative, but experiences create expertise.

Learning by doing increases interest, motivation and skill development in students. The benefits of the learning by doing model are explained by the pyramid of Williams and Shellenberger (1996), presented in the Figure below.

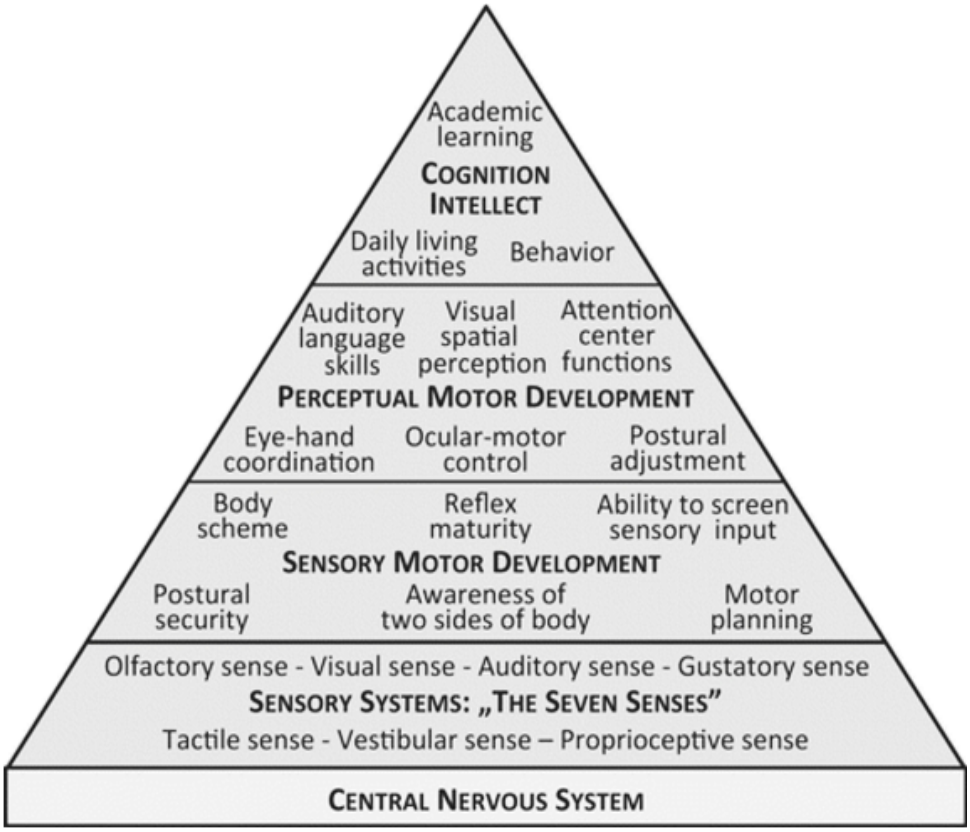


Figure 5. The figure is from Williams and Shellenberger (1996)

Alternatively, the learning pyramid can be represented in another version like the following in Figure 8.

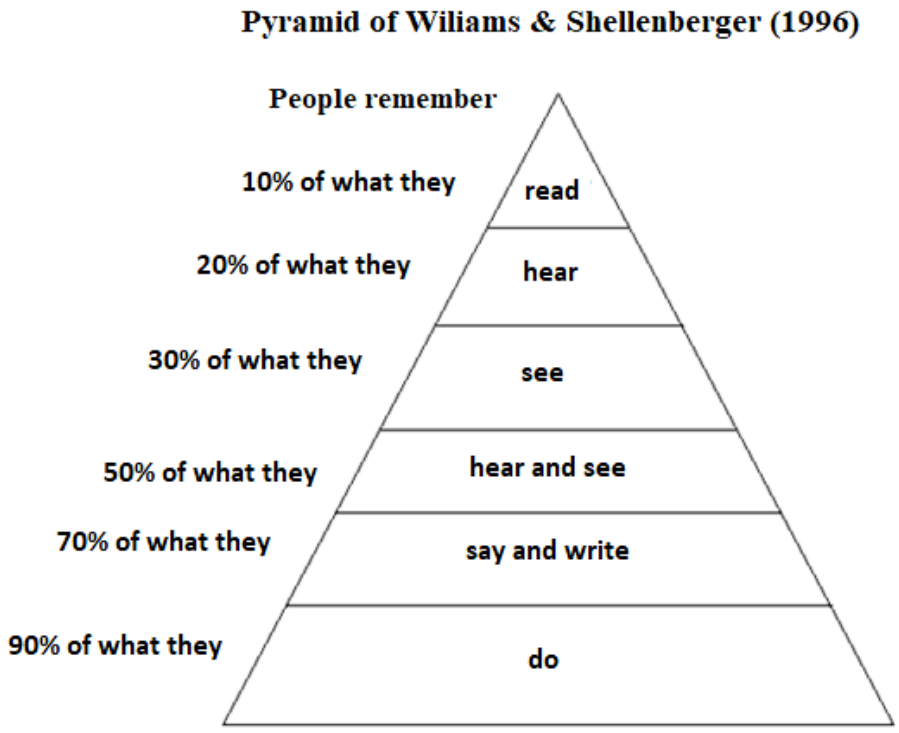


Figure 6. Pyramid of William & Shellenberger, 1996

It is quite clear that learning is most effective when it involves both practice and experience. In this context, the "learning by doing" model is one of the most popular learning models among students and the most effective in terms of their academic achievement.

Learning by doing increases students' cognitive, emotional, and social engagement, which in its turn provokes their active learning, i.e. creating a model of a meta-model of student engagement, presented in Figure 10 on Student Engagement Meta-Model.

META-MODEL OF STUDENT ENGAGEMENT

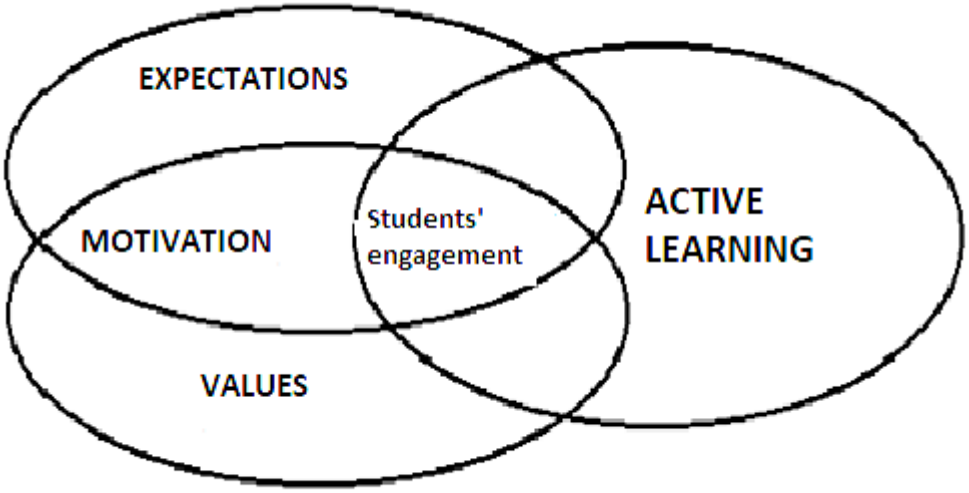


Figure 7. Meta-model of student engagement

BENEFITS OF LEARNING BY DOING

Learning by doing has two strengths:

- emotional experiences such as stress, surprise or joy that occur when performing actions of practice;

- **coping in risky situations,** which increases confidence and self-efficacy in case of success, and remembering mistakes and effective action in case of failure.

Learning by doing:

• Improves engagement and motivation;

• Improves memorization and comprehension;

• Builds critical thinking and problem-solving skills;

• Encourages collaboration and creativity.

Blended /hybrid/ learning

Hybrid learning, also called blended learning, is a combination of face-to-face learning and online platforms, content, and tools for learning personalization.

Driscoll (2002) provides four different definitions of hybrid learning:

1. "To combine or blend different types of web-based technologies (e.g., live virtual classroom, self-paced learning, collaborative learning, streaming video, audio, and text) to achieve an educational goal.
2. To combine different pedagogical approaches (e.g. constructivism, behaviourism, cognitivism) to achieve optimal learning outcomes with or without instructional technologies.
3. Combine any form of instructional technology (e.g., videotape, CD-ROM, web-based learning, film) with face-to-face, instructor-led instruction.
4. To mix or combine learning technologies with real work tasks to create a harmonious effect of learning and work." (Driscoll, 2002).

Picciano (2006) supports the concept of definition by mentioning that blended learning comes in "many shapes, flavours, and colours and therefore looks very different from classroom to classroom."

The emergence of digital technologies in the 21st century and the common use of smartphones, laptops, and tablets in every aspect of daily life are slowly introducing hybrid learning into the basic structure of education.

"True hybrid learning is a way to implement a fundamental change in the learning model towards personalized learning... Hybrid learning designs leverage the strengths of both the classroom and online methods. Changes in the hybrid learning model have the potential to lead to "learning optimization" to create more personalized learning opportunities." (Patrick, Kennedy & Powell, 2013)

According to Horn & Staker (2015), "hybrid modality should allow the learner to have greater control over time, place, path, and pace. This necessitates the use of personalized learning environments, whose modes can vary to some extent.

As Horn & Staker (2015) note, the hybrid learning program can be delivered as follows:

"a) Partially online – online learning with some element of control and flexibility for students over how they learn, including the time, place, pace and path they take.

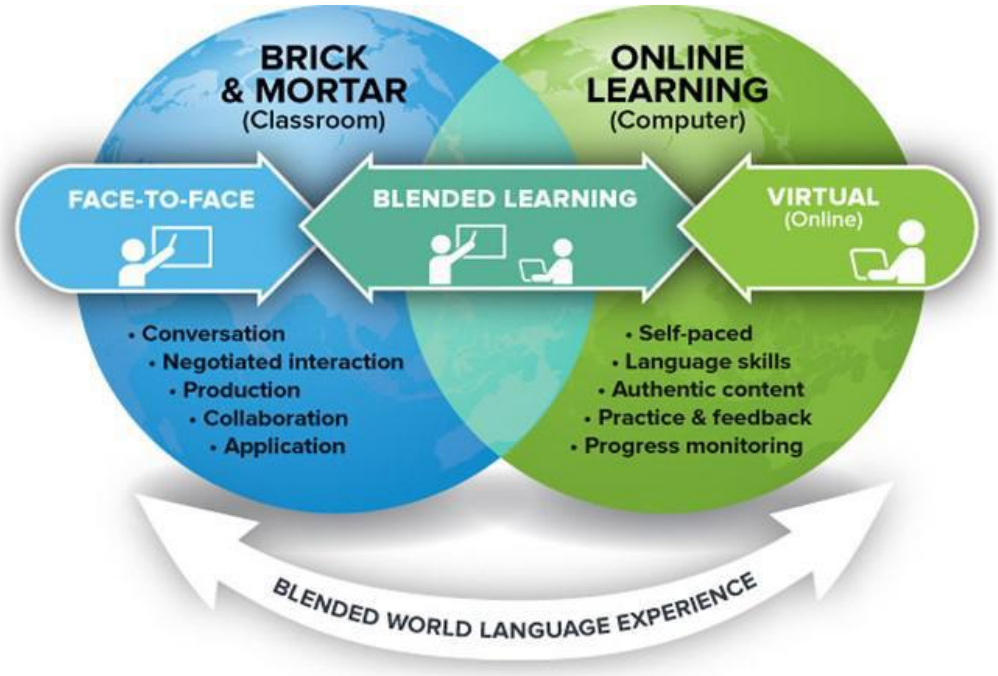
b) Partially away from home – partially or in combination with physical education away from home (education in a physical classroom/school or in the student's home).

c) Through a learning path – a personalized learning path that offers students the opportunity to learn through activities that take advantage of different learning methods."

BLENDED LEARNING MODELS

One of the most popular models belongs to Friesen (2012), according to which "hybrid learning can be placed between fully online and fully face-to-face courses. Therefore, one of the challenges in defining hybrid learning is to determine where it falls on such a continuum." A common model of hybrid learning is shown in the following Figure 8.

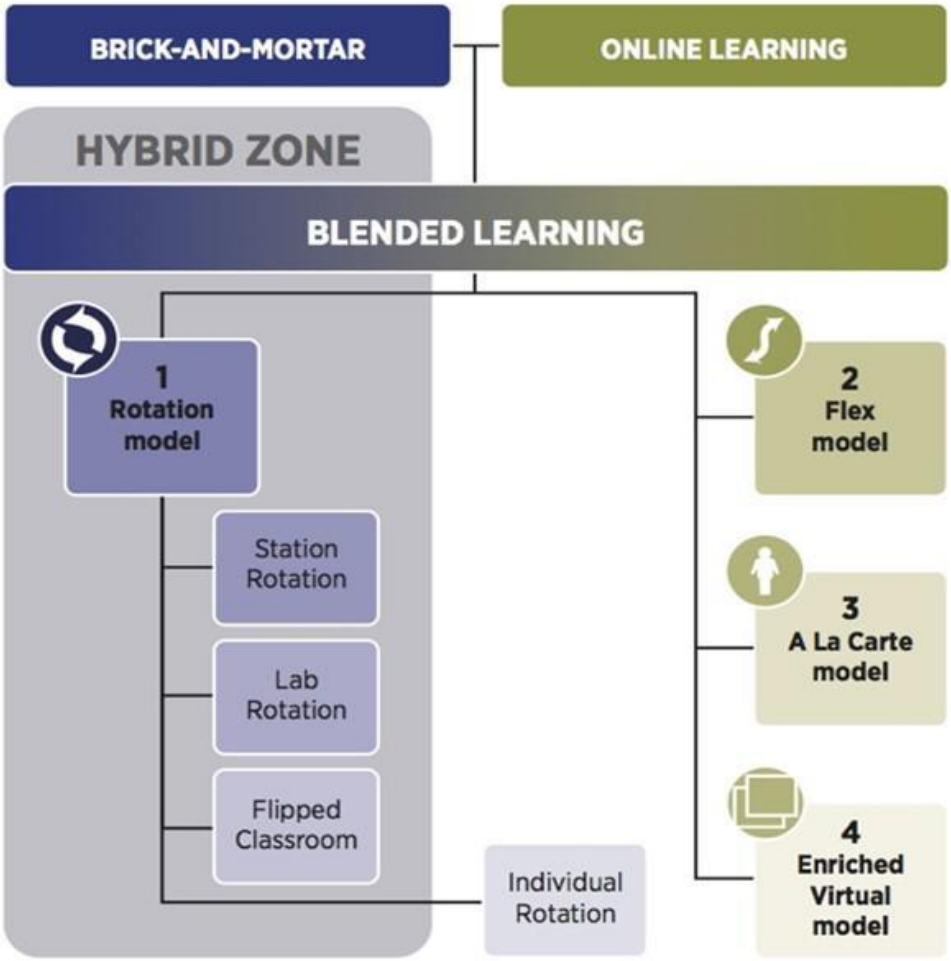
(https://www.middleburyinteractive.com/curriculum-courses/blended-learning).



Fugure 8. Blended world language experience, Friesen, 2012

According to Christensen, Horn, Staker (2014, cited in Ossiannilsson, 2017), there are four models of hybrid learning that suggest differences in learning environments.

The models are presented in the following Figure 9.



Fugure 9. The four models of blended learning according to Christiansen Institute, Christiansen, Horn, and Staker (2014)

1) ***Rotation model***, in which, within a given course or subject (e.g., mathematics), students rotate, on a fixed schedule or at the teacher's discretion, between learning modes, at least one of which is online learning. Other modes may include activities such as small group or whole-class learning, group projects, individual learning, and paper-based assignments. The rotation model has four sub-models, as follows:

- *Station/Classroom Rotation Model* - students take turns in a designated space;
- *Lab rotation model* – students rotate between classroom and online learning;

- *Flipped Classroom Model* – students alternate between face-to-face practices led by a teacher (projects) and outside the school/home for online content and learning;

- *Individual rotation model* – each student essentially has an individual playlist and does not have to rotate to every available station or learning method.

2) ***Flex model*** where students move on an individually personalized, flexible schedule between learning modes, and the lead teacher is on-site.

3) ***An "A la carte" model***, where students attend one or more courses online on or off campus. At the same time, they continue to gain practical experience at school/university.

4) ***The enriched virtual model*** of students divides their time between physical school attendance and distance learning using online content and instructional delivery.

Hybrid learning is an educational approach that combines traditional face-to-face learning with online learning. It is designed to offer flexibility, personalization, and improved engagement by integrating the strengths of both physical and digital environments.

Another model of hybrid learning is being presented by (Mountain House High School, Mountain House, CA), cited in Ossiannilsson (2017)

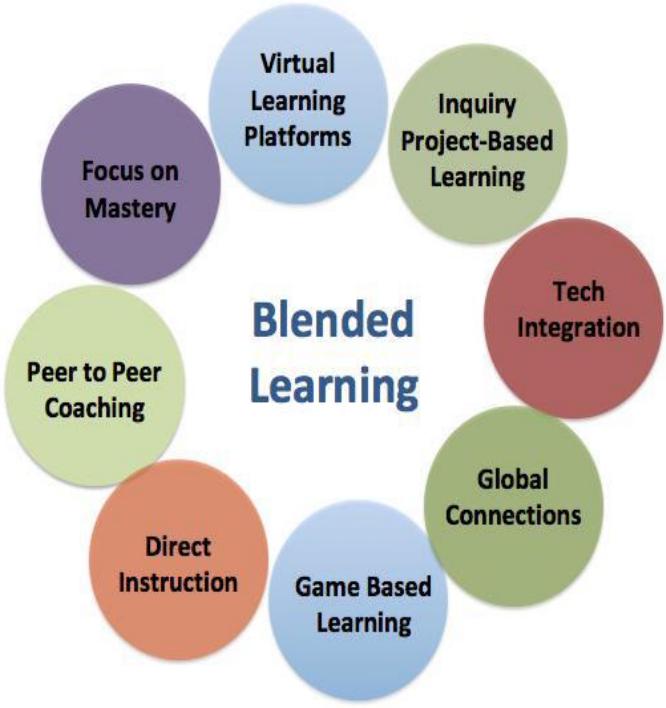


Figure 10. A common model of blended learning. The "blend" in the blended learning model, Ossiannilsson (2017)

Characteristics of blended learning:

• Dual delivery: Combines face-to-face and online components.

• Learner control: Students often choose when and how to interact with the digital content.

• Technologically enhanced: Uses videos, apps, quizzes, and collaboration tools.

• Flexible structure: Can be adapted to different subjects, levels, and learning styles.

Advantages of blended learning:

• Supports personalized learning;

• Increases accessibility and flexibility;

• Improves student engagement;

• Allows for self-paced learning;

• Facilitates data-driven learning through digital tracking.

Challenges of blended learning:

• Requires a strong digital infrastructure;

• Requires teachers to be trained in technological tools and online pedagogy;

• Risk of uneven access to devices or the internet;

• There is a need for careful integration in order to avoid fragmented learning.

Micro-learning

Microlearning is an "innovative, simplified teaching technique that involves subjecting examples of human behaviour to the five Rs: record, review, respond, refine, and re-perform" (Banerjee et al., 2015).

Figure 11. Microlearning, Banerjee et al., 2015

Microlearning is a contemporary educational approach that delivers complex conceptual content in a concise format through individual modules. Each module is brief, typically lasting between 1 and 15 minutes. Each module has a clear learning objective and focuses on a specific topic or skill, creating short learning experiences and having a flexible format that can be text, video, audio, or another model of interactive content presentation. Each module can be customized to the needs of the learner, which highlights the adaptability of micro-learning. It is often used to solve imminent problems or reinforce skills. It is also in line with the dynamics and digitalization of today's world, with the opportunities it provides

for ubiquitous implementation, i.e., anywhere and anytime, with the availability of an electronic device (smartphone, tablet, computer) and the presentation of mobile applications.

Micro-learning models

- **"Traditional" model.** A short lesson is taught to a small group of peers. The aim is to focus on the teaching method, to obtain feedback and to make improvements. A clear structure is followed. Many teachers use this method to work on their classroom presence, voice modulation, or the way they explain a topic. It is accepted as a practice run before the real performance.
- **Component Model.** This model involves breaking down teaching into smaller parts. One area of the entire curriculum is selected. This could be a style of questioning, the way instructions are given, or the way examples are used. By focusing on one skill, it may be worked on more carefully and improvement may be seen more quickly.
- **Interactive model.** In the interactive model, the focus is on discussion and collaboration. Ideas are shared, feedback is given and received, and the session is reflected upon together. Interactions take place not only during teaching, but also before and after. This model helps to understand different points of view and improves the way communication takes place both in the classroom and between teachers and teachers, between students and teachers.
- **Experimental model.** This model is entirely about trying something new. When there is a desire to explore a different teaching method or approach, an experimental method is used. The idea is to step outside your comfort zone and test creative strategies. It may not always work perfectly, but it opens new possibilities in the classroom.
- **Problem-solving model.** The model helps to address challenges in the classroom. First, the problem arising during teaching is identified. Then, possible solutions are explored and tested during the micro-session. This method is useful when dealing with classroom management difficulties, low student engagement, or time management issues.

- **Technology-enhanced model.** Typically applied to working with digital tools in teaching. Involves using technology to support lessons and enhance teaching practice." (https://www.extramarks.com/blogs/teachers/micro-teaching/).

Micro-learning methods

- *Modelling method.* The teacher demonstrates a specific teaching method or technique. The learners then practice the same method or technique themselves. This type of microlearning is effective in helping learners to understand how to complete a particular task, but it is not as effective in understanding why a particular method or technique works.

- *Laboratory method*. The teacher divides the class into small groups that rotate through different stations, with each station focusing on a different skill. This method is excellent for providing hands-on experience for students and allows them to practice multiple skills in a short period of time. However, it can be difficult to implement with large groups of students.

- *Clinical method*. This method is like the laboratory method, but each group works with a different teacher and allows students to receive feedback from multiple sources. However, it can be difficult to manage large groups of students.

- *Lecture method*. This method is one of the most common types of microlearning. The teacher gives a lecture on a specific topic. This type of microlearning is effective for helping learners understand complex concepts. However, it can be less effective for helping them apply those concepts in a practical setting.

Regardless of which microteaching method is used, the strategy remains a useful weapon in every teacher's arsenal.
(https://teacherassist.co.uk/microteaching/microteaching-methods/)

Application of micro-learning

Micro-learning is most often applied:

- variations of microlearning are used with teachers who are starting work, detailing the experiences of participants, both students/teachers and managers/lecturers (Cavanaugh, 2022)
- improving elements of the experience and creating more productive feedback (Godek, 2016).
- mentoring teachers who are just starting work (Johnson & Cotterman, 2015; Godek, 2016; Lederman & Lederman 2019);
- developing of a “professional vision” (Barnhart & van Es, 2015; Tuluce & Cecen, 2018).

Microteaching

Micro-learning includes ***micro-teaching*** , which is applied to:

- increasing self-confidence and teaching self-efficacy (Arsal, 2015; Sen, 2009);
- reflection for self-analysis (Tripp & Rich, 2012; Kourieos, 2016; Sydnor, 2016; Welsh & Schaffer, 2016)
- etc.
- developing self-confidence, providing constructive criticism, and fostering a positive attitude toward microteaching (Ajileye & Ajibola, 2013) .
- professional presentation skills (Hussain & Masrur, 2011).
- encouraging reflection and discussion when choosing a topic (Ghafoor, Kiam & Kayani, 2012)

Microlearning creates conditions for more effective perception, understanding, and assimilation of learning information; it takes into account the ability to focus and concentrate attention for a short period of time; it minimizes cognitive overload and creates opportunities for repeated learning experiences. The ability to repeatedly repeat and repeat the perception of the respective module leads to the consolidation of learning information and, accordingly, to the prevention or overcoming of the psychological phenomenon known as the "Ebbinghaus effect" or "the reduction of memory over time when there is no attempt to reinforce the

learned information. The iterative approach of microlearning can neutralize this curve, thereby promoting better memory retention. Providing interval repetition of the content and timely reintroduction of the learning units ensures the transfer of knowledge from short-term to long-term memory. In addition, breaking down complex lessons into smaller, manageable units helps to avoid mental fatigue, thereby improving attention, motivation, and retention, as suggested by Shayle (2019)".

(https://www.i3-technologies.com/en/blog/stories/education/exploring-microlearning-examples-benefits-and-drawbacks/).

Advantages of microlearning

- Improves the long-term retention of learning information and the acquisition of knowledge.
- Increases learner engagement by quickly delivering relevant and personalized learning content.
- Allows independent learning.
- Maintains the interests, cognitive, emotional, and social engagement of learners through brief presentations of focused learning content.
- Ability to personalize training by taking into account the individual needs and progress of the individual learner.
- Supports personal development through constant and ongoing learning and assimilation of new information.
- Economic efficiency by reducing training costs and time.
- It provides flexible access through ubiquity, i.e. learning anytime, anywhere, which in turn makes microlearning extremely suitable for mobile devices.
- Educational and social inclusion with access opportunities for learners who do not have access to traditional education.
- Realizing social impact with opportunities to improve quality of life.

Challenges and problems of micro-learning

- Limiting in-depth learning of complex topics due to the short and focused duration of the individual module.
- There is a risk of disconnected knowledge and fragmented learning if lessons are not well structured.
- Possibility of low learner engagement when the perceived value of short-duration modules is devalued.
- Taking a lot of time to plan and design effective micro-learning modules.
- Difficult to track progress and measure long-term learning outcomes.
- Possible consequences such as low A-efficiency, inappropriately increased self-esteem, stress, social stigma, etc.
- Inability to use in environmental contexts characterized by low or no access to the internet network or appropriate electronic devices.

Content vs. skills

Through the shift towards a more competency-based approach in education, the distinction between "content" and "skills" has become fundamental.

Content and skills are essential components of education that work together to enhance learning. While content refers to the body of knowledge learners learn, skills represent the abilities they develop to apply that knowledge effectively. Content includes subject-based knowledge, such as factual information, concepts, theories, and principles within a subject area (Lazarov, 2020), which is conveyed through textbooks, lectures, projects, and assignments. It provides a foundation of knowledge, core concepts, and principles of a subject. It is typically assessed quantitatively through tests and exams. In mathematics, content might include formulas, theorems, and problem-solving techniques. In history, content could involve dates, events, and biographies of historical figures. In science, content encompasses scientific laws, experimental procedures, and theoretical models.

Skills, on the other hand, refer to the abilities and competencies learners develop to apply knowledge in real-world contexts (Levterova-Gajdalova, 2020). Skills enable learners to

think critically, solve problems, and work effectively with others, preparing them for the real-world challenges they will face. Skills are assessed through performance-based tasks and are often measured qualitatively, for example, through evaluation rubrics. For example, 21st-century skills include critical thinking, communication, and collaboration. Together, content and skills equip learners with both the knowledge and practical abilities needed in today's world.

While content and skills are distinct, it is important to understand that content knowledge and skills are deeply interconnected and difficult to separate or prioritise over one another. This can be exemplified by the knowledge and skill requirements for a job. For example, for a leader, the ability to lead and the relevant subject-related expertise are closely linked and difficult to separate. (Lonka, 2015)

Acquiring content knowledge provides the basis for developing higher-order skills. For example, understanding mathematical formulas enables learners to apply them to solve complex problems. Conversely, developing skills such as critical thinking and problem-solving helps learners deepen their understanding of the content. Moreover, using their skills to analyse historical events, for instance, strengthens learners' understanding of historical context and causality. (Lonka, 2015)

Effective, well-rounded and future-oriented education balances content acquisition with skill development. It integrates both content and skills into the curriculum to ensure that learners gain both content knowledge in different subjects and the ability to apply and work with the acquired knowledge effectively, meaningfully and creatively.

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Phenomenon-based learning

Phenomenon-Based Learning (PhBL) is an innovative educational approach focused on a central phenomenon that serves as the cornerstone for learning. PhBL emphasises authenticity, interaction, constructivist learning, self-directedness, and interdisciplinarity. In addition, it aims to support learners in developing their skills in learning to learn, metacognitive awareness, and media literacy. Phenomenon-based learning can be applied through various methods, such as inquiry-based learning, problem-based learning, project-based learning and portfolio-based learning (Aarnio, 2016). PhBL has been integrated into various levels of education, ranging from early childhood education to higher education (Wolff, 2022).

While traditional pedagogy has its merits in terms of efficiency and standardisation, phenomenon-based learning offers a more engaging and relevant approach to education. As subject-based teaching provides a limited perspective to the real world, PhBL aims to provide a holistic view and deeper understanding by integrating multiple subjects. This encourages learners to explore and understand the interconnectedness of different disciplines. As approaches to implementing PhBL, integrative education and multidisciplinary learning provide insight into the connections between various subjects and fields. In general, integrative education aims to facilitate the learners' understanding of links and interdependencies among the studied subjects and topics. Multidisciplinary learning modules are "learning units that integrate topics from different fields of knowledge and are based on the cooperation of different subjects". (Peltomaa, 2021) In this handbook, this kind of multidisciplinary PhBL-based entity is referred to as PhBL project.

Unlike in traditional knowledge-based instruction, which often emphasises memorisation and repetition, the development of 21st-century skills is a slower, more complex process. However, it promotes more profound understanding, better problem-solving abilities, and learners' ability to transfer skills into different contexts. It is essential to allocate sufficient time to develop these skills. (Luostarinen & Peltomaa, 2016)

According to Sillander (2015), the key dimensions of phenomenon-based learning are holisticity, authenticity, contextuality, inquiry-based learning, and the learning process. Holisticity means that different subjects are combined to create a complete and connected learning experience. Authenticity refers to the learning tasks that are real-world, practical and relevant to everyday life. Contextuality in learning means that learning is tied to meaningful situations or environments, which makes learning more relatable. Problem-based inquiry focuses on learners' questioning and exploration to solve real-world problems. In PhBL, the focus is on the learning process that involves learning tasks that guide and facilitate learning. According to Sillander's (2015) rubric on PhBL, the depth and effectiveness of the PhBL experience depend on how extensively these dimensions are addressed in the pedagogical design of a PhBL project. It is advisable to apply the method in a manner and to an extent that supports the teacher's familiarity with the method and the learners' skill level.

By focusing on a single phenomenon, such as climate change, learners engage in inquiry-driven and experiential learning, asking questions and seeking answers through hands-on activities and investigations. This approach fosters curiosity and a holistic understanding and emphasises both formative and summative assessments throughout the learning process. As learners delve into the phenomenon from various angles, they develop a deeper conceptual understanding and make interdisciplinary connections, moving beyond practical applications to grasp the broader implications of the subject matter.

The key differences between traditional pedagogical methods and phenomenon-based learning

	Traditional pedagogical methods	**Phenomenon-based learning**
Focus	Knowledge transmission from the teacher to learners	Learner-centred inquiry and discovery
Role of the teacher	Authority figure, primary source of information	Facilitator, guide, mentor, emotional supporter, inspirer

Role of the learner	Passive recipient	Active participant, explorer, critical thinker, creative agent, innovator, researcher
Instructional Method	Lectures, direct instruction	A variety of methods, e.g. inquiry-based learning
Curriculum Structure	Linear, structured	Flexible, adaptable
Assessment	Tests, exams, and rote memorisation	Formative and summative assessments, self- and peer assessments
Level of Learner Engagement	Low or moderate	High
Depth of Understanding	Surface level	Deep, connected understanding
Skill Development	Basic skills	Higher-order skills (critical thinking, etc.)
Relevance to the Real World	Limited real-world connection	Highly relevant to real-world contexts

Theoretical roots and pedagogical applications

Phenomenon-based learning (PBL) is an educational approach that uses real-world phenomena or events as the starting point for learning (Lonka, 2018a). As a modern pedagogical approach, it is rooted in educational psychology, constructivist learning theories, inquiry-based learning, problem-based learning, and phenomenology (Schaffar & Wolff, 2024) and sociocultural learning theory (Lonka, 2018b).

A phenomenon can be defined as:

> *"a fact or situation that has become an object of observation and is affected by several factors working independently in the background. Also, temporary movements, events and fashion trends are also often called phenomena."* (Sitra, 2025)

As an example, climate change is a phenomenon that carries the following meaning: *"The ongoing anthropogenic climate change is mainly caused by an increase in the amount of greenhouse gases, especially carbon dioxide, in the atmosphere. If emissions continue to rise at the present rate, the global average surface temperature will rise between two and six degrees by the end of this century due to the amplification of the greenhouse effect. In some parts of the world, changes in precipitation will lead to more severe droughts and in others, an increased risk of flooding"* (Climateguide, 2025).

From a learning perspective, a phenomenon must be observable to exist. Phenomena can vary greatly in their nature, characteristics, and attributes. They can be, for example, cultural, mathematical, or physical, or they can be an event or a series of events. For learning, a phenomenon is optimal when it is sufficiently diverse in terms of subjects and learning goals, and can be examined using different scientific disciplines or fields. (Lonka et al., 2015). For a teacher, it is beneficial to choose a phenomenon that is relevant to the locally-taught curriculum and can be approached from many subject-specific standpoints (Aarnio, 2016).

Moreover, the selected phenomenon should align with local curriculum goals while also reflecting the school's educational values. Established traditions and school-wide practices can serve as a foundation for expanding into broader learning experiences. To make PhBL-based learning more engaging and relevant, they can be designed to involve locally important themes and timely issues. For example, in a community where forestry is a key industry, forestry-related themes can be incorporated into the phenomenon. Learning can be made timelier and more relevant for learners by addressing current societal issues, political discussions, or global trends that help connect learning to real-world contexts. (Luostarinen & Peltomaa, 2016)

Before integrating a PhBL, learners need to have the basic skills and concepts needed to study the phenomenon in question. For example, when exploring climate change as a phenomenon, it is important to make sure the learners are familiar with relevant concepts, such as the atmosphere, the ozone layer, and greenhouse gases, as well as key knowledge in history and physics. (Sanomapro, 2025) For effective learning, it is crucial, yet challenging, to narrow down the phenomenon enough, but not too much. (Sanomapro, 2025). Honkonen and

Lehmuskoski (2015) advise that a too widely defined phenomenon can be unmotivating or challenging to make sense of. In turn, if a phenomenon is defined too narrowly, it may restrict the exploration of different perspectives.

PhBL emphasises learners' agency and engagement in their own learning process. In PhBL, the learner is regarded as a researcher and explorer. They are given an active and creative role to "act as a cognitive and motivational captain of their own learning, which enhances a coherent and meaningful learning experience" (Lonka 2018). The key focus of PhBL is on the learner's ability to observe phenomena and the learner's insights that arise from it. Learning is centred on how learners adopt information through their senses and process it based on their experiences, prior knowledge, and personal goals (Kauppila, 2007). Learner's agency refers to their "effectiveness in regulating their cognitive, affective, and behavioural processes." (Code, 2020).

The teacher's role in PhBL shifts from being a primary source of knowledge to acting as a facilitator, mentor, coach, emotional supporter, and inspirer (Lonka et al., 2015; Taimela, 2017). A significant part of the teacher's time is dedicated to supporting learners as they navigate their own learning journeys, offering individualised guidance and encouragement. (Luostarinen & Peltomaa, 2016) In addition, the teacher's role requires planning the structure of content knowledge and skill building by determining the learning environment, setting learning goals, and selecting learning tools. On the other hand, the teacher's role is to foster a safe and encouraging learning atmosphere and support learners in their learning process. (Lonka et al., 2015; Luostarinen & Peltomaa, 2016)

In PhBL, the teacher guides and encourages learners to take ownership of their own learning, collaborate, set appropriate questions, conduct research, think critically and creatively, develop their learning skills together, describe and present their learning process and evaluate themselves and their peers. Teacher also executes assessment continuously during the learning and gives individual support for learning when needed. (Taimela, 2017) As PhBL is based on learners' responsibility and agency, it is important to pay attention to learners' motivation. A teacher can enhance motivation in learners by encouraging and inspiring them to learn.

Besides fostering the development of content knowledge and skills, it is essential to actively involve and engage learners in shaping their learning experience. This can be supported by providing opportunities for them to contribute ideas, whether by selecting themes, choosing topics of interest, or suggesting learning methods. Allowing learners to have a say in the tools, activities, and assessment methods used can further increase motivation. Learning experiences should begin with learners' existing knowledge, interests, and strengths, and the purpose of the subsequent learning process is to broaden their perspectives. Teachers play a key role in expanding learners' understanding by providing new viewpoints and methods for exploration. (Luostarinen & Peltomaa, 2016)

The extent of collaboration between teachers in creating a multidisciplinary learning module at different educational levels depends on how deep subject-specific expertise is required from the teachers. Typically, a class teacher has specialisation in many subjects, which may require little or no collaboration with other teachers (e.g., a special education teacher). However, in the context of secondary and higher education, teachers typically have expertise in one or a few subjects. Consequently, creating a multidisciplinary project in this context requires more intensive collaboration between teachers. (Luostarinen & Peltomaa, 2016)

Whenever collaboration between teachers is needed, it is beneficial to build it on trust, shared expertise, and teamwork. Ideally, it entails an ongoing iterative cycle of improvement that consists of planning, implementation, evaluation, and returning to planning with new learnings and insights. Successful cooperation means being open to colleagues' ideas during brainstorming, lesson planning, guiding learners, managing challenges, and conducting assessments. It involves committing to joint efforts, navigating uncertain situations proactively together, taking responsibility for both individual and collective tasks, maintaining a positive team dynamic, celebrating achievements, and ensuring effective communication. It is also beneficial to recognise each teacher's strengths, such as skills in educational technology or learner engagement, and make use of them. (Luostarinen & Peltomaa, 2016)

Co-creating modules enables educators to learn from one another, exchange expertise, and experiment with new teaching approaches within their school environment. When suitable, multidisciplinary projects can be extended beyond the classroom, incorporating

partnerships with local stakeholders, such as businesses and organisations. (Luostarinen & Peltomaa, 2016)

Since PhBL is often an emotionally activating approach, it challenges learners' emotional capacity. For learners unfamiliar with this approach, the shift from traditional approaches may be initially overwhelming. To develop an active learning mindset and take responsibility for their learning, learners need to practice self-regulation, resilience, and adaptability. (Luostarinen & Peltomaa, 2016) Consequently, teachers need to be ready to guide and support learners with emotional regulation, especially in the case of negative feelings, such as anxiety and uncertainty (Lonka et al., 2015). For learning, it is crucial that the learning environment feels psychologically safe and everyone feels welcome to participate and contribute their ideas (Aarnio, 2016).

There are no detailed instructions for constructing or implementing a phenomenon-based learning process. Thus, each teacher can adjust PhBL to suit their style of teaching (Lonka, 2018b). PhBL can be implemented through a variety of pedagogical approaches (Wolff, 2022), such as inquiry-based learning, problem-based learning, project learning, portfolio-based learning (Aarnio, 2016) or engaging learning environment model (ELE) (Lonka, 2018b). According to Lonka et al. (2015), especially inquiry-based learning (see e.g. Pedaste et al., 2015) provides a well-rounded methodological approach for applying PhBL.

Inquiry-based multidisciplinary learning encourages learners to explore topics through active participation, fostering curiosity while offering diverse ways to learn and develop skills. The emphasis is on collaboration, problem-solving, and real-world applications that introduce a variety in teaching strategies, learning environments, and instructional tools. (Luostarinen & Peltomaa, 2016)

In inquiry-based learning, instruction is built on four key phases: orientation, conceptualisation, investigation and conclusion (Pedaste et al., 2015b). Each phase can be designed to cover methodology that supports the development of the targeted skills and subject content.

The purpose of the orientation phase is to introduce the phenomenon and spark inherent curiosity, engagement and interest in learners. Orientation can involve visiting a place

(e.g., an organisation, a natural location, a theatre play, or a science museum), inviting expert guests to discuss the phenomenon, or providing other orientation materials, such as art or textual pieces relevant to the phenomenon being examined.

In the conceptualisation phase, learners are guided to explore the topic and formulate questions and hypotheses based on their explorations. Learners can be guided and encouraged to ask questions from different perspectives and be involved in defining and narrowing down the phenomenon being studied. These can involve examining the phenomenon with questions from political, geological, chemical, mathematical, historical, and biological perspectives. (Aarnio, 2016) Learners can be assigned to groups based on their interests and questions. For this, the teacher can encourage learners to ask questions about the phenomenon. Then, these questions can be used to organise learners into groups based on their interests. This phase can also include goals for diagnostic evaluation, such as the use of mind maps to assess learners' prior knowledge. These mind maps can be used in the later phases as assessment material of what has been learned during the process. (Taimela, 2017)

In the investigation phase, learners plan and execute their research project or experiments. The teacher's role in this is to help groups set joint goals for learning about the phenomenon, define the tasks, roles of participants, and the division of labour. It is also important that the teacher makes sure that all learners are learning the key learning objectives (Aarnio, 2016) The group's topic can be examined by gathering and evaluating information or performing experiments, e.g. through surveys or interviews, lab work etc. (Taimela, 2017)

The conclusion phase typically includes creating final outputs, presenting findings and reflections of the learning process. In this phase, it is beneficial for learners to have the opportunity to choose their preferred form of output. The options for final outputs can involve preparing a presentation or a poster, writing an essay or a blog post, preparing a research or survey report, creating a visual representation (e.g., through video, animation, or photography), or organising an event, such as a school fair. (Aarnio, 2016; Pedaste et al., 2015b; Taimela, 2017)

	Orientation	Conceptualisation	Investigation	Conclusion
WHAT?	Learners are provided with an orientation to the project	Learners set questions and generate hypotheses	Learners both a) research or experiment with their topic b) evaluate and classify information	Learners create a final output of what they have learned
HOW?	Orientation ideas: - visit a place - arrange an expert presentation - watch a video or a movie - read a text, e.g., an article, a fairy tale	- the chosen phenomenon is defined and narrowed down - teams are formed and their project topics are chosen	- setting goals and tasks for collaboration in teams - gathering and evaluating information or performing experiments, e.g. through surveys, interviews, lab work etc.	- a team creates e.g. an essay, a research report, a video, a visual narrative, an animation, a presentation, a photography exhibition, a blog, a survey report, a poster, an event

Figure 12. Phases of inquiry-based learning and their practical application ideas in phenomenon-based learning (adapted from Pedaste et al., 2015b; Taimela, 2017)

For learners to engage deeply with key concepts and work purposefully, PhBL projects should be planned with adequate time for exploration. It is recommended that a module should last approximately the number of hours a learner spends at school in one week. In Finland, for example, the recommended length of a module is 19-20 hours for first and second graders and 27-30 hours for seventh to ninth graders. The module can be structured as an intensive week-long experience or designed to spread over multiple weeks, such as an eight-week period. (Luostarinen & Peltomaa, 2016)

Assessing the learning process in Phenomenon-based learning projects

Assessment is the most crucial pedagogical instrument for teachers in directing learning and carrying out educational activities. Traditional educational practices often involve learners working individually, focusing on memorising facts or performing simple tasks. These activities are typically conducted without the use of books, computers, or social networks. The

work is then shared solely with the teacher, who usually provides only minimal feedback. Moreover, learners are provided with few opportunities to make revisions. (Binkley et al., 2012) Assessing the learning process in PhBL requires a shift from these traditional assessment methods to more process-oriented and learner-centred ways of assessing learning. The assessment in PhBL emphasises the evaluation of learners' ability to apply knowledge, think critically, and solve problems within the context of real-world phenomena.

For a PhBL project, it is essential to base evaluation on learning goals and criteria rather than comparing learners' performance with one another. Learning goals and objectives are established in national or local curricula. These objectives serve as the basis for deriving the assessment criteria for a subject or learning task. These criteria explain what learners need to know and be able to do to achieve each grade level. The criteria can include, for example, how an "excellent" performance is distinguished from a "good" or "poor" one. Evaluation can be designed to cover aspects of learning, working and behaviour. It is helpful for learners to have learning goals and assessment criteria visually available. This can be achieved by creating rubrics that outline specific criteria for assessing the selected learning objectives, such as collaboration. These learning objectives and criteria can be visualised as a matrix or a tree on a classroom wall. (Luostarinen & Peltomaa, 2016)

You can search for assessment rubrics using search engines on the internet (Ovaska et al., 2014). Alternatively, if your organisation approves the use of AI in pedagogical planning, you can also utilise openly available AI tools, such as ChatGPT (OpenAI, 2025), and employ prompting tactics (see e.g. AI for Education, 2025) for drafting assessment rubrics.

Instead of providing feedback at the end of a learning process, the assessment of a PhBL project should be designed to support learning continuously throughout the project and encompass various assessment methods, with a focus on formative, self-assessment, and peer assessment. From a teacher's perspective, assessing 21st-century skills involves continuous observation, offering formative feedback that is encouraging and development-oriented, as well as goal-setting and scaffolding to facilitate learners' learning. This approach also involves arranging learners' opportunities for self- and peer-assessment (Luostarinen & Peltomaa, 2016). Instead of only providing feedback on past performance, assessment should "feed

forward," which means that learners receive needs-based support throughout the learning process and receive information on how to improve their skills in the future (Gonzalez, 2018). Continuous and simultaneous assessment is possible if learners are guided towards continuous self-assessment and peer-assessment practices. These, however, need to be taught and practised often before a project starts. (Lonka, 2018b)

Suggested key assessment methodologies for a PhBL project include diagnostic assessment, formative assessment, summative assessment, and self- and peer-assessment.

1. Diagnostic assessment

Diagnostic assessment "examines the knowledge and skills that a pupil has already learnt". (Jones, 2023) Diagnostic assessment serves several key purposes in the learning process. it helps identify gaps in learners' understanding, enabling educators to address these areas before introducing new concepts. It informs instructional planning by revealing learners' current knowledge and skills, allowing lessons to build on existing understanding while targeting areas for improvement. Additionally, it establishes a baseline for tracking progress and evaluating instructional strategies over time. By offering insights into learners' preferences and needs, diagnostic assessment supports differentiated instruction, ensuring each learner receives tailored educational support.

Diagnostic assessment methods offer diverse ways to evaluate learners' existing knowledge and skills. Pre-tests help gauge prior understanding before new instruction begins, while surveys and questionnaires capture detailed insights into misconceptions. Concept maps and mind maps enable learners to represent their learnings visually. This provides information on areas where there are gaps in understanding. Observations provide teachers with real-time perspectives on problem-solving approaches, and self-assessments (see e.g. Marchant (2023) for KWL charts) invite learners to reflect on their strengths and areas needing improvement. (Marchant, 2023)

2. Formative assessment

Formative assessment involves evaluating learners continuously during the whole learning process. The aim is to support learning by providing constructive feedback and helping learners understand how they are progressing toward their goals and what objectives

they should set next. Formative assessment serves as a tool to aid learning (assessment for learning) and contains a guiding and development-focused perspective (assessment as learning) (Luostarinen & Peltomaa, 2016). Formative assessment is particularly beneficial for learners with weaker skills when the purpose of the assessment is to support the implementation of the next steps in the learning process (scaffolding) (Binkley et al., 2012) .

In a PhBL project, formative assessment methods can be integrated into each phase of projects life cycle. At different phases of learning, it is important to provide learners opportunities to assess their own learning process as well as their own and others' actions. (Lonka et al., 2015)

Formative assessment methods include regular observations and discussions to monitor learners' participation, collaboration, and engagement during activities. Teachers can also utilise checkpoints, such as short quizzes, to evaluate understanding of key concepts at different points in the learning process. Reflective journals or learning logs allow students to document their thoughts, questions, and discoveries, fostering deeper engagement. Additionally, portfolios, which comprise a selection of a learner's work, provide a comprehensive view of learners' progress and achievements over time while also helping them track their development and understand their strengths and areas for improvement. (LuKiMat, 2025)

3. Summative assessment

Traditionally, summative assessment has been used to assess overall learning at the end of a unit or project and give feedback on what has already been learned. It typically does not involve ideas on how to improve performance in the future. To support learning after the learning period, summative assessments should also include guidance and descriptions on how learners can improve their skills in the future. This type of assessment for learning includes a description of learners' strengths and areas of mastery, as well as identifying areas that need improvement. As a ratio for effective assessment feedback, it is often beneficial to mention 3 strengths and areas of mastery to one area of improvement (Luostarinen & Peltomaa, 2016).

At the end of a phenomenon-based project, summative assessment is based on final outputs. In their final outputs, learners showcase their understanding of the phenomenon and their findings. These can involve, for example, presentations, essays, portfolios or photo exhibitions.

4. Self-assessment and peer assessment

Self- and peer-assessments can be included in a PhBL-based project. In self-assessment, learners use assessment criteria to reflect on their own work, pinpoint areas for improvement, and enhance the quality of their output accordingly. Peer assessment involves learners evaluating the work of their peers according to established criteria related to a specific learning objective and providing constructive feedback to help improve their peers' performance. The purpose of self-assessment is to develop one's skills in metacognitive awareness and the learner's ability to assess, orient, and regulate one's own learning experience. Usually, learners do not acquire this ability outside school, so it needs to be taught. To make self- and peer-assessment effective for learners, it is important to share encouraging feedback and foster an accepting, safe, open and trusting atmosphere in the group. (Luostarinen & Peltomaa, 2016) Self-assessment can be taught through tasks that require self-reflection, guiding learners to reflect on their own learning and identify strengths and areas for improvement. In peer assessment, learners provide constructive feedback to one another based on the evaluation criteria. Methods for self- and peer-assessment include, for example, the Scrum method (Peltomaa, 2021) and learning journals (Rongas & Laaksonen, 2014) .

Transforming operating culture for phenomenon-based learning: myths, realities, and strategies

Integration of phenomenon-based learning poses certain challenges for the operational culture of educational institutions. The culture in many educational institutions does not support the general goals of PhBL, which include, for instance, increasing learners' agency, engagement, and participation, diversifying assessment methods, implementing 21st-century (transversal) skills, and enhancing cooperation between teachers.

In educational settings, certain cultural myths surround the implementation and effectiveness of PhBL. In education, a cultural myth is "a sociocultural structure and learned thought construct that either promotes or prevents change in an educational institution and intuitively guides everyday choices and actions". Similarly, a pedagogical myth can be regarded as "a well-established conviction that contradicts current knowledge concerning pedagogical truths" (Heland-Kurzak, 2020). Awareness and conscious debunking of cultural and pedagogical myths can help to create a more PhBL-friendly environment for learning. (Peltomaa & Luostarinen, 2020)

Peltomaa and Luostarinen, (2020) list and describe four cultural myths in education that might influence the implementation of a PhBL project. These myths are 1) transfer of knowledge, 2) efficiency, 3) the immutability of education and 4) preparation for exams. (Peltomaa & Luostarinen, 2020)

Transfer of knowledge

The notion that the teacher is the provider of knowledge while learners are mere recipients is a common myth in the educational world. It restricts learners' active participation and critical thinking, reducing their role to that of passive learners. To counteract this, teachers can encourage learners to ask questions, seek knowledge independently, and construct their own understanding. Additionally, it is beneficial to act as a guide or facilitator and provide support throughout the learning process. Leverage the knowledge of your collaboration with

fellow teachers for co-teaching and continuously acquiring new knowledge. (Peltomaa & Luostarinen, 2020)

Efficiency

The efficiency myth suggests that effective learning happens if teachers tightly control it. In traditional instruction, learning time is divided into short periods to cover content quickly rather than promote deep understanding. As a consequence, this myth prevents deep understanding and the meaningfulness of learning. To counter this myth, it is beneficial to support learners' ownership of their learning. Also, it is important to create an environment that is emotionally supportive, meaningful, experiential, and enjoyable. Additionally, diverse resources should be made available for acquiring knowledge that can be easily used to organise and apply information effectively. Allowing sufficient time to explore phenomena in-depth is crucial, as it fosters comprehensive and long-term learning. Emphasising the deep understanding and meaningfulness of learning further enhances the educational experience. (Peltomaa & Luostarinen, 2020)

The unchanging nature of education

The belief that learning standards and levels remain unchanged despite changes in the world around us is a misconception. This myth overlooks the continuous evolution of society and the job market, which alters societal needs for learning. In the reality, many learning outcomes of traditional education are becoming outdated and irrelevant in today's world.

To counteract this myth, learners can be provided with opportunities to tailor their learning to their personal needs and interests and explore content that sparks their creativity and curiosity. In this process, teachers can still define common and essential goals for all learners, while allowing flexibility to differentiate instruction up or down without compromising required educational standards. By involving learners in the planning of content, methods, and the assessment of their own skill levels, education becomes more participatory and meaningful. Furthermore, creating an environment that encourages learners to delve into phenomena from multiple perspectives ensures that learning remains dynamic, flexible, and relevant to contemporary needs. (Peltomaa & Luostarinen, 2020).

Preparation for exams

The myth that the primary goal of learning is to succeed in exams limits the development of transversal skills such as critical thinking, problem-solving and teamwork skills. This can be counteracted by focusing more on developing 21st-century (transversal) skills and integrating diverse assessment methods that support the learning process holistically. It is advisable to use both formative and summative assessment methods. (Peltomaa & Luostarinen, 2020)

The four cultural myths in education and means to counteract their effect in phenomenon-based learning

Myth	Description	Limitation	Tips for counteracting the myth
Transfer of knowledge	The teacher is the primary source of knowledge, and the role of the learner is to receive information.	This myth limits learners' active participation and critical thinking, as they are often considered passive recipients of knowledge.	• Encourage learners to ask questions, seek and construct knowledge themselves. • Act as a guide and facilitator, supporting learners in their learning process. • Collaborate with other teachers for co-teaching and acquiring new knowledge
Efficiency	Learning is efficient when the teacher controls the learning process and scheduling. For this, time is divided into short segments and	This myth prevents deep understanding and the meaningfulness of learning by focusing on quantitative	• Support learners' agency of their learning by providing ➢ emotional, meaningful, experiential and joyful learning environment ➢ diverse resources for knowledge acquisition

	covering content is more important than understanding it	learning rather than qualitative.	➢ opportunities to organise and apply information • Give learners time to delve into phenomena and learn about them in a diverse, deep and long-term manner. • Emphasise deep understanding and the meaningfulness of learning.
The Unchanging Nature of Education	Learning standards and levels remain unchanged even though the world around us changes.	This myth does not consider the constant changes in society and the job market, which make learning outcomes outdated and irrelevant.	• Adapt learning to the needs and interests of learners • Leave space for learners' creativity and highlight learning content that interests them. • Include general and important goals and content for everyone, but also allow differentiation upward or downward when it serves your learners. • Involve your learners in the planning of educational content and methods as well as in defining and evaluating the level of competence.

			• Provide learners with the opportunity to explore and understand phenomena from different perspectives, making learning more flexible and up-to-date.
Preparation for exams	The primary goal of learning is to succeed in exams.	This myth limits the development of future (transversal) skills, such as critical thinking, problem-solving and teamwork	• Focus on developing 21st-century (transversal) skills and integrate diverse assessments that support the learning process • Utilise both formative and summative assessment methods

(Peltomaa & Luostarinen, 2020)

Characteristics of students with special educational needs

Special educational needs is a term used in many education systems to describe the wide range of needs of students affected by disabilities or disorders that affect their learning and development (https://www.oecd.org/en/topics/special-education-needs.html). These difficulties can manifest themselves in a variety of areas, including learning, communication, social interaction, and physical or sensory abilities.

"**Disability** is neither a purely biological nor a social construct, but the result of interactions between health conditions and environmental and personal factors. It can manifest itself at three levels: impairment of body function or structure; limitation of activity, such as inability to read or move; limitation of participation, such as exclusion from school or work." (WHO, 2001, https://apps.who.int/gb/ebwha/pdf_files/WHA66/A66_12-en.pdf)

Intellectual disabilities, disorders of intellectual development

In ICD-11, intellectual disabilities (ID) are defined by the term **disorders of intellectual development** with code 6A00. They are defined as „a group of etiologically diverse conditions originating during the developmental period characterised by significantly below average intellectual functioning and adaptive behaviour that are approximately two or more standard deviations below the mean (approximately less than the 2.3rd percentile), based on appropriately normed, individually administered standardized tests." Intellectual disabilities are included in section 6 of ICD-11 Mental, behavioural and neurodevelopmental disorders. They are syndromes characterised by clinically significant disturbance in an individual's cognition, emotional regulation, or behaviour that reflects a dysfunction in the psychological, biological, or developmental processes that underlie mental and behavioural functioning. These disturbances are usually associated with limitation in personal, family, social, educational, occupational, or other areas of functioning (http://id.who.int/icd/entity/605267007).

According to ICD-11, in order to speak of intellectual disabilities, the following ***essential features*** must be present:

- The presence of significant limitations in intellectual functioning across various domains such as perceptual reasoning, working memory, processing speed, and verbal comprehension. There is often substantial variability in the extent to which any of these domains are affected in an student.
- The presence of significant limitations in adaptive behaviour, which refers to the set of *conceptual, social, and practical* skills that have been learned and are performed by people in their everyday lives.
- Onset occurs during the developmental period.

There are many medical conditions that can cause ID and are associated with additional medical problems. A variety of prenatal (e.g., exposure to toxic substances or harmful medications), perinatal (e.g., birth problems), and postnatal (e.g., infectious encephalopathies) factors can contribute to the development of intellectual disability.

Additional characteristics may include problematic or challenging behaviours such as aggression, self-injurious behaviour, attention seeking, oppositional defiant behaviour, and sexually inappropriate behaviour. They may need additional support to adapt to changes in routine, structure, or educational settings.

Intellectual disabilities are lifelong conditions that usually manifest in early childhood and require consideration of developmental stages. In students, they may manifest as problems in acquiring academic knowledge and skills such as reading, writing, arithmetic, etc.

According to the modern classification of intellectual disabilities, which is determined by IQ, there are **4 degrees**: mild, moderate, severe and profound.

In **mild** DID, intellectual functioning and adaptive behaviour are found to be approximately 2 to 3 standard deviations below the mean, based on appropriately normed, individually administered standardized tests. The students often exhibit difficulties in the acquisition and comprehension of complex language concepts and academic skills. Most master basic self-care, domestic, and practical activities. They can generally achieve relatively independent living and employment as adults but may require appropriate support.

In **moderate** DID, intellectual functioning and adaptive behaviour are found to be approximately 3 to 4 standard deviations below the mean. Language and capacity for acquisition of academic skills of learners vary but are generally limited to basic skills. Some may master basic self-care, domestic, and practical activities. Most of them require considerable and consistent support in order to achieve independent living and employment as adults.

In **severe** DID, intellectual functioning and adaptive behaviour are found to be approximately 4 or more standard deviations below the mean. The persons exhibit very limited language and capacity for acquisition of academic skills. They may also have motor impairments and typically require daily support in a supervised environment for adequate care, but may acquire basic self-care skills with intensive training. Severe and Profound DID are differentiated on the basis of adaptive behaviour differences.

In **profound** DID, intellectual functioning and adaptive behaviour are found to be approximately 4 or more standard deviations below the mean. Persons possess very limited communication abilities and capacity for acquisition of academic skills is restricted to basic concrete skills. They may also have co-occurring motor and sensory impairments and typically require daily support in a supervised environment for adequate care.

According to Levterova-Gadjalova and Atanasova, cognitive skills such as intelligence, memory, attention, language, speech, thinking, perception and functions such as planning actions, decision-making, etc. are affected in ID. General and fine motor skills are affected. The perception of information is slow and inaccurate. Attention is short-term and easily shifted by external factors. Disturbances are observed in short-term and long-term memory. The assimilation of new knowledge is extremely slow after repeated repetitions. Thinking is concrete and there is difficulty with abstract thinking. Disturbances in the motor sphere are expressed in incoordination, inaccuracy, incorrect execution of more complex actions with the hands. (Levterova-Gadjalova, 2016; Atanasova, 2019).

Below are described **behavioural indicators of intellectual functioning** according to ICD-11.

In **mild ID during the early childhood** they will develop language skills and be able to communicate needs. Delays in the acquisition of language skills are typical and they have limited vocabulary. Most can:

- attend to a simple cause-effect relationship;
- attend to and follow up to 2-step instructions;
- make one-to-one correspondence or match to sample (e.g., organize or match items according to shape, size, colour).
- communicate their immediate goals (e.g., desired activities for the day)
- develop emergent reading and writing skills;
- be able to recognize letters from their name and some can recognize their own name in print.

During the period of childhood and adolescence they can develop the following abilities:

- to communicate effectively;
- to tell their age;
- to initiate/invite others to participate in an activity;
- to communicate about past, present and future events;
- attend to and follow up to 3-step instructions;
- to identify different denominations of money (e.g., coins) and count small amounts of money;
- to identify many of their relatives and their relationships

Some can orient themselves in the community and travel to new places using familiar modes of transportation. Most can: read sentences with five common words; count and make simple additions and subtractions.

In the **moderate level** during early childhood under 6 years of age, most can:

- develop language skills and will be able to communicate their needs. Delays in acquiring language skills are typical, and once acquired, they are often less developed than those of typically developing peers (e.g., more limited vocabulary).
- follow one-step instructions;

- initiate activities themselves and engage in parallel play;
- distinguish between “more” and “less”;
- recognize symbols.

Some develop simple interactive play, pay attention to simple cause-and-effect relationships, make one-to-one correspondences, or match with a sample (e.g., organize or match objects by shape, size, color).

At a moderate level during childhood from 6 to 18 years of age, they can:

- effectively express their needs;
- state or identify their age and gender;
- initiate/invite others to participate in an activity;
- share immediate experiences;
- attend and follow instructions up to 2 steps.

Most can develop beginning reading and writing skills; recognize their own name written in letters; choose the correct number of objects. Some can learn to count to 10.

In the **severe level**, during early childhood, they can develop a variety of simple nonverbal strategies to communicate basic needs. Most can pay attention to others and respond to them; separate one object from a group on request; stop an activity on request; make rudimentary signs that are precursors to letters on the page. Some can initiate activities themselves. In the period from 6 to 18 years, in the severe stage, most can use communication strategies to show preferences, initiate activities, pay attention and recognize familiar pictures; follow 1-step instructions and stop an activity on request; distinguish between “more” and “less”; separate one object from a group on request; recognize symbols.

In the **profound level** in early childhood, many will develop nonverbal strategies for communicating basic needs. Most can start and stop activities with prompts and aids. They will not learn to read or write. And from ages 6 to 18, most will develop strategies for communicating basic needs and preferences and can perform very simple tasks with prompts and aids. Some can separate one object from a group on demand; distinguish locations and their associated meanings.

Physical disabilities

These are children and students with congenital, post-traumatic and postoperative conditions with permanent residual functional motor disorders (Atanasova, 2019).

According to Levterova (2016), motor deficits can cause specificity in the sensory, physical, intellectual and socio-emotional development of children and students with physical disabilities. Intellectual functions can be below, within or above the norm.

In ICD-11, they are defined as Developmental motor coordination disorder with code 6A04 (http://id.who.int/icd/entity/148247104).

They are characterized by significant delays in the acquisition of gross and fine motor skills and impairment in the performance of coordinated motor skills, manifested by clumsiness, slowness, or inaccuracy of motor performance. Coordinated motor skills are significantly below what would be expected given the individual's chronological age and level of intellectual functioning. The onset of difficulties with coordinated motor skills occurs during the developmental period and is usually evident by early childhood. These difficulties cause significant and lasting limitations in functioning (in activities of daily living, schoolwork, occupational and recreational activities). They may be due to a disease of the nervous system, a disease of the musculoskeletal system or connective tissue, a sensory impairment, and more, and are not explained by an intellectual developmental disorder. Cerebral palsy falls into this group.

Additional features of physical disabilities are:

- Children may have delays in achieving motor milestones (e.g., sitting, crawling, walking), although many of them achieve typical early motor milestones. The acquisition of skills such as climbing stairs, buttoning shirts, solving puzzles, tying shoes, and using zippers may be delayed or difficult. Even when a skill is achieved, the execution of movements may seem awkward, slow, or less precise than that of their peers. Children may drop things, stumble, bump into obstacles, or fall more often than their peers.
- Affect primarily gross motor function, primarily fine motor function, or both aspects of motor function.

- Students are slow or inaccurate in a variety of activities that require fine or gross motor activity, such as team sports, handwriting, assembling models or other objects, or drawing maps.
- Co-occur with other disorders. These disorders can interfere with activities of daily living, schoolwork, and occupational and recreational activities that require coordinated motor skills.

Children with physical disabilities may have concomitant problems with disruptive behaviour, anxiety and depression, emotional lability, and increased fatigue. They tend to have lower levels of self-efficacy and competence in physical and social skills.

Students with physical disabilities may have difficulties with mobility and movement, sitting, writing, endurance, speaking, and reading, and learning disabilities. Cerebral palsy may have disturbances in attention and memory, in sensations and perception, vision, hearing, affecting speech development, difficulties in arithmetic tasks, motor clumsiness, impaired visual-motor coordination in space. They may have difficulty maintaining posture and standing in a sitting or upright position. (Atanasova, 2019).

Learning disabilities

The term specific learning disabilities (SLDD) describes students who have specific difficulties in mastering school skills. They usually perceive, process and express information in a different way, which affects their learning (Levterova-Gadjalova, 2016). They have learning disabilities that manifest as specific difficulties in reading (dyslexia), writing (dysgraphia), mathematical skills (dyscalculia) and spatial-temporal representations. Mastering these skills is a serious challenge for students. They learn these skills, but more difficultly than their peers (Atanasova, 2019).

In ICD-11, SLDD is defined as a developmental learning disorder with code 6A03. It is characterized by significant and persistent difficulties in mastering academic skills, which may include reading, writing or arithmetic. The student's achievement in the affected academic skills is significantly below that expected for chronological age and general level of intellectual functioning and results in significant impairment of the individual's academic or vocational

functioning. It is first evident when academic skills are taught in the early school years. It is not due to an intellectual developmental disorder, sensory impairment (vision or hearing), neurological or motor disorder, lack of access to education or language proficiency, academic learning, or psychosocial difficulties. Learning limitations are evident despite appropriate academic instruction. The limitations may be limited to a single component of the skill or may affect all of reading, writing, and arithmetic (http://id.who.int/icd/entity/2099676649).

The disorder includes disorders of:

- **reading** − learning difficulties are manifested in disorders of reading skills, such as accuracy of reading words, reading fluency, reading comprehension. There are omissions, substitutions of words or parts of words, long hesitations, exchange of words in sentences or letters in words (according to ICD-11 and Atanasova, 2019).
- **written expression** − manifested in disorders of writing skills, such as accuracy of spelling, grammatical and punctuation accuracy, organization and cohesion of ideas in writing. Printed and handwritten graphic signs are mixed, handwriting is illegible, does not follow the horizontal line, writes slowly and with inappropriate pressure on the sheet (according to ICD-11 and Atanasova, 2019).
- **mathematics** − manifested in disorders of mathematical skills, such as number sense, memorization of numerical facts, accurate calculation, smooth calculation, accurate mathematical reasoning. They have difficulty with basic arithmetic operations, visual and auditory perception, motor development, have poor mathematical memory, difficulties in comparing volume, size, shape, quantity, etc. (according to ICD-11 and Atanasova, 2019).

Students with SNSU show impairments in various basic psychological processes, which may include phonological processing, orthographic processing, memory, executive functions such as planning, learning and automating symbols (e.g. visual, alphanumeric), perceptual-motor integration and speed of information processing. It is assumed that deficits in these psychological processes underlie the child's ability to acquire academic skills. Many students have pronounced difficulties with self-regulation of attention, which can have consequences for academic performance and hinder response to intervention or support.

According to Levterova (2005), SNSU can be grouped into:

- General disorders – relate to motor and cognitive development, as well as behavior and social relations;
- Specific disorders – are related to the peculiarities of the development of higher cortical functions: gnosis, praxis, memory, thinking, encoding and decoding of information.

The disorders can also be expressed in behavioral characteristics, such as difficulties in organizing activity, difficulties in concentrating attention and in completing the task set; in linguistic competence: difficulties in expressive verbal production and in the reception of speech (Atanasova, 2019).

Autism spectrum disorder

Autism spectrum disorder (ASD) with code 6A02 in ICD-11 is characterised by persistent deficits in the ability to initiate and to sustain reciprocal social interaction and social communication, and by a range of restricted, repetitive, and inflexible patterns of behaviour, interests or activities that are clearly atypical or excessive for the individual's age and sociocultural context. The onset of the disorder occurs during the developmental period, typically in early childhood. Deficits cause impairment in personal, family, social, educational, occupational or other important areas of functioning. Individuals exhibit a full range of intellectual functioning and language abilities (http://id.who.int/icd/entity/437815624).

Social communication limitations are in relation to the following:

- Understanding, interest in, or inappropriate responses to the verbal or nonverbal social communications of others.
- Use of nonverbal cues, such as eye contact, gestures, facial expressions, and body language.
- Understanding and using language in social contexts and the ability to initiate and maintain reciprocal social conversations.
- Social awareness, resulting in behaviour that is not appropriately modulated according to the social context.

- Ability to represent and respond to the feelings, emotional states, and attitudes of others.
- Mutual sharing of interests.
- Ability to form and maintain typical peer relationships.

Behaviour patterns may include:

- Lack of adaptability to new experiences and circumstances, with associated distress that may be triggered by changes in familiar environments or in response to unexpected events.
- Inflexible adherence to certain routines;
- Excessive adherence to rules (e.g., playing games).
- Excessive and persistent ritualized patterns of behaviour (e.g., preoccupation with arranging or sorting objects in a particular way);
- Repetitive and stereotyped motor movements of the whole body (e.g., rocking), atypical gait (e.g., toe walking), unusual hand or finger movements, and posture.
- Persistent preoccupation with one or more special interests, parts of objects, or specific types of stimuli (including media), or an unusually strong attachment to certain objects.
- Excessive and persistent hypersensitivity or hyposensitivity to sensory stimuli or an unusual interest in sensory stimuli, which may include actual or anticipated sounds, lights, textures (especially clothing and food), smells and tastes, heat, cold, or pain.

Important features of ASD include intellectual disability, functional language impairment, and loss of previously acquired skills, i.e. regression of cognitive and adaptive skills. Functional language refers to the ability of an individual to use language for instrumental purposes (e.g., to express personal needs and desires). It reflects primarily the verbal and nonverbal expressive language deficits present in some individuals with ASD, rather than pragmatic language deficits. The degree of functional language impairment relative to age can be: none or mild, impaired, complete, or nearly complete. In middle childhood, there may be

prominent symptoms of anxiety, school refusal, and phobias. Pragmatic language difficulties may manifest as literal comprehension of the speech of others, speech that lacks normal prosody and emotional tone, and is monotonous, lack of awareness of the appropriateness of language choice in certain social contexts, or pedantic precision in language use. Self-injurious behaviour (e.g., face-slapping, head-banging) may occur.

According to Levterova-Gadjalova (2016), the main positions of manifestation of ASD are in: qualitative disorders in reciprocal social integration; qualitative disorders in verbal and nonverbal communication and in creative activities; presence of repetitive activities and interests and hyper- or hypoactivity for sensory perception or unusual interests in sensory aspects of the environment (indifference to pain/temperature, adverse reactions to specific sounds or textures, aromas or when touching objects, visual interest in lights or movement). Children and students with ASD do not like change in the environment and routine activities, are afraid of the unknown, and may show aggression.

In preschool children, avoidance of mutual eye contact, resistance to physical affection, lack of social imaginative play, delayed or precocious language development but not used for social conversation; social withdrawal, obsessive or repetitive activities, and lack of social interaction with peers, characterized by parallel play or lack of interest; sensory sensitivity to everyday sounds or foods.

Typical of childhood are resistance to participation in unfamiliar experiences and pronounced reactions to even small changes in routine, social isolation. Excessive focus on details, as well as rigidity of behaviour and thinking, can be significant. Anxiety is present.

The ICD-11 describes some ASD syndromes:

- Asperger syndrome, characterized by no intellectual disabilities and no or mild impairment in functional language;
- Syndrome with intellectual disabilities and no or mild impairment of functional language,
- Heller syndrome with intellectual disabilities and impairment of functional language, with or without loss of acquired skills.

- Atypical autism - without intellectual disability, with or without lack of functional language and with or without loss of previously acquired skills.
- Kanner syndrome or pervasive developmental disorder and refers to unspecified ASD.

Emotional and behavioural disorders

Atanasova (2019) cites Slavin, who defines emotional behavioural disorders as "pertaining to children and students whose performance in educational institutions is significantly negatively affected for a long period of time by some of the following circumstances:

- inability to learn that cannot be explained by intellectual, educational, sensory or health factors;
- inability to build or maintain satisfying interpersonal relationships with peers or others;
- inappropriate types of behaviour or feelings under normal circumstances;
- a general, deep and persistent mood of unhappiness and depression;
- a tendency to develop somatic symptoms or fears related to personal or school problems."

Hyperactivity or attention deficit hyperactivity disorder (ADHD) is behavioural disorder with code 6A05 in ICD-11. It is characterised by a persistent pattern (at least 6 months) of inattention and/or hyperactivity-impulsivity that has a direct negative impact on academic, occupational, or social functioning. It manifests itself in early to mid-childhood. The degree of inattention and hyperactivity-impulsivity is outside the range of normal variation expected for age and level of intellectual functioning. The syndrome manifests itself in a variety of situations or settings (at home, at school, at work, with friends or relatives), but is likely to vary depending on the structure and demands of the setting." (http://id.who.int/icd/entity/821852937).

The main symptoms of ADHD are three: hyperactivity, impulsivity, and inattention, which can vary to different student and change over the course of development. Attention deficit can occur with or without hyperactivity.

Symptoms of inattention are typically as follows:

- Difficulty sustaining attention to tasks that do not provide a high level of stimulation or reward or require sustained mental effort; lack of attention to detail; making careless mistakes in schoolwork or failure to complete.
- Easily distracted by external stimuli or thoughts; often does not seem to listen when spoken to and appears to be daydreaming.
- Loses things; forgets in daily activities; forgets to complete upcoming daily tasks or activities; has difficulty planning, managing, and organizing schoolwork, assignments, and other activities.

Inattention may not be apparent when the student is engaged in activities that provide intense stimulation and frequent rewards.

Symptoms of hyperactivity/impulsivity are as follows:

- Excessive motor activity; leaves seat when expected to sit still; often runs around; has difficulty sitting still without fidgeting; feeling physically restless, feeling uncomfortable with silence or sitting still.
- Difficulty participating quietly in activities; talking too much.
- Burbles answers in school, comments at work; difficulty waiting one's turn in conversation, games, or activities; interrupts or intrudes on others' conversations or games.
- Tendency to act in response to immediate stimuli without thinking or considering risks and consequences.

ADHD syndrome, according to Atanasova (2019), is associated with a set of difficulties affecting 4 aspects: cognitive - attention deficit, impulsivity, inability to organize time; emotional aspect - impatience, emotional instability; social aspect - social isolation, poor social judgment; motor aspect - hyperactivity, difficulties with motor coordination.

Emotional disorders in preschool and school age mainly include anxiety, depression, and fear conditions, which are generally reversible and transient. School functioning is affected and can lead to failures and disruption of social integration (Atanasova, 2019).

Sensory impairments

Sensory impairments include “two main groups of neurosensory disorders caused by disorders in the auditory and optic nerves, creating an obstacle in the perception and processing of information coming through these channels.” (Atanasova, 2019). According to Atanasova, they cause secondary cognitive and language disorders of a general nature, poor sound pronunciation, difficulties in phonemic discrimination and literacy, and lead to difficulties in learning, communication and socialization.

Visual impairments

According to ICD-11, visual impairment occurs when a specific condition of the eye affects the visual system and one or more of its visual functions. Visual acuity is used to determine it, with severity categorized as mild, moderate, or severe distance vision impairment or blindness, and near vision impairment. Other visual functions are also assessed, such as visual field, contrast sensitivity, binocular stereoscopic vision, light perception, and colour vision. (http://id.who.int/icd/entity/30317704, http://id.who.int/icd/entity/1103667651).

Blindness is coded 9D90.6 in ICD-11 and is profound, nearly complete, or total loss. These are individuals who have little or no residual vision and who must rely primarily on substitute vision skills, i.e. to use senses other than sight (Braille or talking books for reading, a long cane or guide dog for mobility, or touch for manipulation) (http://id.who.int/icd/entity/49873717).

Near vision is coded 9D90.7 in ICD-11 and refers to the ability to perform tasks that require detailed vision at close range. Near vision impairment is characterized by impaired visual acuity for near vision (http://id.who.int/icd/entity/504779294).

Visual impairments extend to the areas of: orientation and mobility, cognitive intelligence, communication, social attitude and health. They experience difficulties in the motor-motor sphere; formation of spatial representations, in emotional and linguistic development, attention, memory and thinking, in the acquisition of concepts, etc. (Atanasova, 2019).

Hearing impairments

Students with hearing impairments are those who have permanent complete or partial hearing loss, as a result of which the formation of oral speech and communication is difficult (Atanasova, 2019). Deafness and low hearing are distinguished. In ICD-11, hearing impairments are distinguished into: acquired, congenital, with complete, partial and central hearing loss, as well as by frequency - low and high frequency.

They affect: thinking, which has certain inhibitions; memory - reduced to deliberate memorization; imagination - has peculiarities; speech - is characterized by peculiarities of pronunciation, the prosodic side of speech; difficulties in mastering reading and writing skills, etc. (Atanasova, 2019).

Language and speech disorders

The concept of “communication disorders” (CD) means inadequate use of linguistic and extralinguistic means of communication under the influence of pathogenic factors. Communication disorders can be differentiated into two main groups of disorders: non-verbal and verbal communication. “There is a classification of verbal communication disorders built by combining two basic principles of analysis of CD – linguistic-behavioural and medical. Thus, two global categories are distinguished according to the first principle, which is leading – speech and language, and according to the second – developmental and acquired disorders” (Tsenova, 2015). Primary communication disorders are designated by the term specific, in order to mark the cases when CD appears in the form of a primary developmental pathology affecting the language and speech function. In cases when it appears as a result of another

disorder, they are marked as secondary. According to this classification, communicative disorders are (Tsenova, 2015):

- speech disorders (the external formation of the utterance, the realization of the language ability through oral speech, speech is affected):
  - partial speech disorders – phonation or articulation is impaired and include: voice disorders; dysphonia-aphonia; rhynophonia; developmental articulatory disorders;
  - complete speech disorders – two or more elements of speech production are affected. Speech is completely disrupted to the point of incomprehensibility and include: prosodic developmental disorders and acquired: bradylalia and tachylalia; stuttering and stuttering; dysarthria – acquired dysarthria-anarthria and developmental dysarthria; apraxia – acquired speech and developmental speech apraxia; biochemical developmental speech disorders;
- language disorders – language ability is affected as a higher cognitive, psychological ability to operate with linguistic codes and rules: oral language disorders – cover the generation and comprehension of speech; developmental aphasia and dysphasia; written language disorders – cover both components of written language – writing and reading, which may be equally or unevenly affected; alexia and agraphia; specific and secondary dyslexia;
- mixed developmental and acquired disorders, which include combinations of two or more disorders.

In ICD-11, language and speech disorders are presented in the rubrics of developmental speech or language disorders with code 6A01. They arise during the developmental period and are characterized by difficulties in understanding or pronouncing speech and language or in using language in context for the purposes of communication, which are outside the limits of normal variations expected for age and level of intellectual functioning. These difficulties result in significant impairment in social communication or in

personal, family, social, educational, occupational, or other important areas of functioning (http://id.who.int/icd/entity/33269655).

Developmental articulation disorders are considered a developmental speech disorder. They are characterized by difficulties in the acquisition, production, and perception of speech that result in persistent errors in pronunciation, articulation, or phonology, either in the number or type of speech errors made, or in the overall quality of speech, and result in reduced intelligibility and significantly impair communication. Phonological speech errors may be persistent or inconsistent. It may be associated with inaccuracy and inconsistency of the oral movements necessary for speech (apraxia or dyspraxia of speech), which leads to difficulty pronouncing sequences of speech sounds, specific consonants and vowels, and appropriate prosody (intonation and rhythm of speech) (http://id.who.int/icd/entity/551966778). Articulation disorders are associated with omission or absence of sound, substitution or replacement of one sound by another, distortion of sounds, which are signs of simplification of the difficult sound. ANR are associated with the term “dyslalia”, which is “articulation disorder with normal intelligence, preserved physiological hearing and preserved innervation of the speech apparatus.” (Levterova, 2011).

Voice disorders are a speech pathology affecting the qualities of the voice necessary for the adequate external formation of the verbal message (Tsenova, 2015). According to ICD-11, aphonia is the inability to produce voice, and dysphonia is characterized by difficulty or pain in pronouncing or speaking.

The term dysarthria refers to a complete speech disorder - of articulation, phonation, fluency, intonation and rhythm of speech, caused by disturbed innervation of the speech organs due to lesions in the speech motor system (Tsenova, 2015).

Developmental language and speech disorders include developmental speech fluency disorders, which include stuttering, stammering, etc. It is characterized by frequent or widespread disruption of the normal rhythmic flow and pace of speech.

speech, characterized by repetitions and prolongations of sounds, syllables, words and phrases, as well as blocking and avoidance or substitution of words. The disorder is persistent over time. (http://id.who.int/icd/entity/654956298).

Stuttering and stammering are defined as genetically caused disorders of speech fluency in development and are accompanied by structural and functional brain abnormalities.

Stuttering is characterized by persistent and frequent or widespread disruption of the rhythmic flow of speech (typical symptoms of stuttering, core symptoms) and by common accompanying symptoms such as anxiety related to speech and avoidance of speech situations. It significantly affects communication. Typical symptoms are repetitions of sounds, syllables or monosyllabic words, prolongations, word interruptions, audible or silent speech blockages, insertions of sounds and syllables or excessive use of interjections. Associated symptoms are strategies to control, avoid or avoid fluency disturbances, for example through muscle tension, irregular breathing, coordinated movements of facial muscles, head or limbs (http://id.who.int/icd/entity/620587253).

Stuttering is characterized by persistent and frequent or widespread disruptions in the rhythmic flow of speech (typical stuttering symptoms), which are atypical of stuttering. It impairs communication and intelligibility. Typical symptoms are higher than normal or irregular speech rate, or both, disruptions in word and sentence structure with phonological abnormalities, syllable fusion or omission, unusual pauses, unusual syllabic stress or unusual speech rhythm, and difficulty maintaining normal patterns of sounds, syllables, phrases or pauses (http://id.who.int/icd/entity/616505365).

Language disorders are presented under the rubric of developmental language disorder and are characterized by persistent deficits in the acquisition, comprehension, production or use of language (spoken or signed) that emerge during the developmental period and cause significant limitations in the individual's ability to communicate. The individual's ability to understand, produce or use language is significantly below that expected for his or her age. (http://id.who.int/icd/entity/862918022).

Language disorders are classified according to whether receptive or expressive speech is affected, as well as pragmatics.

Language disorder with impairment of receptive and expressive language is characterized by persistent difficulties in acquiring, understanding, producing, and using language that emerge during the developmental period, usually in early childhood, and cause

significant limitations in the individual's ability to communicate. The ability to understand spoken or signed language (i.e., receptive language) is significantly below the expected level given the individual's age and level of intellectual functioning, and is accompanied by persistent impairment in the ability to produce and use spoken or signed language (i.e., expressive language). It is considered developmental dysphasia or aphasia, receptive type. (http://id.who.int/icd/entity/822134099).

Developmental language disorder with predominantly expressive language impairment is characterized by persistent difficulties in the acquisition, production, and use of language that emerge during the developmental period,

usually in early childhood, and cause significant limitations in the individual's ability to communicate. The ability to produce and use spoken or signed language (i.e., expressive language) is significantly below the expected level given the individual's age and level of intellectual functioning, but the ability to understand spoken or signed language (i.e., receptive language) is relatively intact. It is considered developmental dysphasia or aphasia, expressive type. (http://id.who.int/icd/entity/822134099).

Developmental language disorder with predominantly pragmatic language impairment is characterized by persistent and marked difficulties in understanding and using language in social contexts, such as making inferences, understanding verbal humor, and resolving ambiguous meanings. These difficulties cause significant limitations in the individual's ability to communicate. Pragmatic language abilities are significantly below the expected level, given the individual's age and level of intellectual functioning, but the other components of receptive and expressive language are relatively intact. (http://id.who.int/icd/entity/854708918).

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Curriculum on climate change and environmental protection as a guiding document

To align everyday educational efforts with global and local sustainability issues, developing a curriculum on climate change and environmental protection is crucial for educating learners about the pressing issues facing our planet and empowering them to take an action. According to UNESCO's declaration on education for sustainable development (UNESCO, 2022), multidisciplinary environmental education and education for sustainable development (ESD) are crucial components that should be integrated into curricula worldwide. The European Union (EU) promotes the integration of sustainability education into national curricula (European Commission, 2025). For this, the EU has established a European sustainability competence framework called GreenComp (Joint Research Centre, 2022). According to a recent EU report (European Commission et al., 2024), these competences have already been addressed by the national curricula in most European countries.

For example, the Finnish national core curriculum for primary and lower secondary education (Finnish National Agency for Education, 2014) addresses various aspects of sustainability and eco-social education. Firstly, learning to practice a sustainable lifestyle is seen as one of the value-based guiding principles of education. Also, goals for environmental education have been integrated into subject-specific curricula. Also, a significant goal for comprehensive and secondary education in Finland is to develop 21st-century (transversal) skills. For more information, see Road to 21st Century Competence – Evaluation Framework for Transversal Competences in the Finnish Curriculum (Claned Group & ELE Finland, 2017). To support these educational goals, the Finnish curriculum incorporates integrative education, multidisciplinary learning, and phenomenon-based learning as pedagogical approaches.

National, local and grade-specific educational goals need to align with the goals of a PhBL project. By identifying these goals, the phenomenon-based project can be designed to involve the locally relevant goals, objectives, contents, pedagogical approaches and assessment methods, as well as the practices for collaboration, division of work between

teachers and means for development and monitoring the project. (Peltomaa, 2021) For example, the Bloom's taxonomy (University of Arkansas, 2022) can be used as a tool for designing the learning objectives and assessment criteria for a PhBL project.

Consequently, subject-related core contents, learning goals, objectives and assessment methods as well as 21st century skills are key ingredients in constructing a PhBL-based project (Peltomaa & Luostarinen, 2020). A PhBL project on climate change can be designed to incorporate goals for various subjects. As examples, it can comprise goals in geography, such as the exploration of maps or the circulation of water, or in mathematics, such as calculating climate change-related tasks, e.g., temperatures. Learning objectives for history may include discussions on historical developments, such as the Industrial Revolution, that have contributed to climate change.

The subject-specific components do not need to be taught separately. Instead, they should be integrated into the project's structure. Whenever possible, learners should have opportunities to personalise their learning experience, choosing topics, methods, and tools that align with their interests. Providing autonomy fosters authentic engagement and encourages learners to take ownership of their learning. (Peltomaa & Luostarinen, 2020)

In addition to subject-specific goals, PhBL projects emphasise 21st-century skills (Lonka, 2018b). The national and local curricula can be utilised to determine the relevant skills for different grade levels. For 21st-century skills, the project may be designed to focus, for example, on collaboration, problem-solving, and metacognitive skills. To support the development of these skills, educators should carefully select and prioritise relevant skills based on learners' age and learning needs. Clear learning objectives help maintain focus, guide instructional choices, and ensure learners understand what they are expected to learn and practice. (Peltomaa & Luostarinen, 2020).

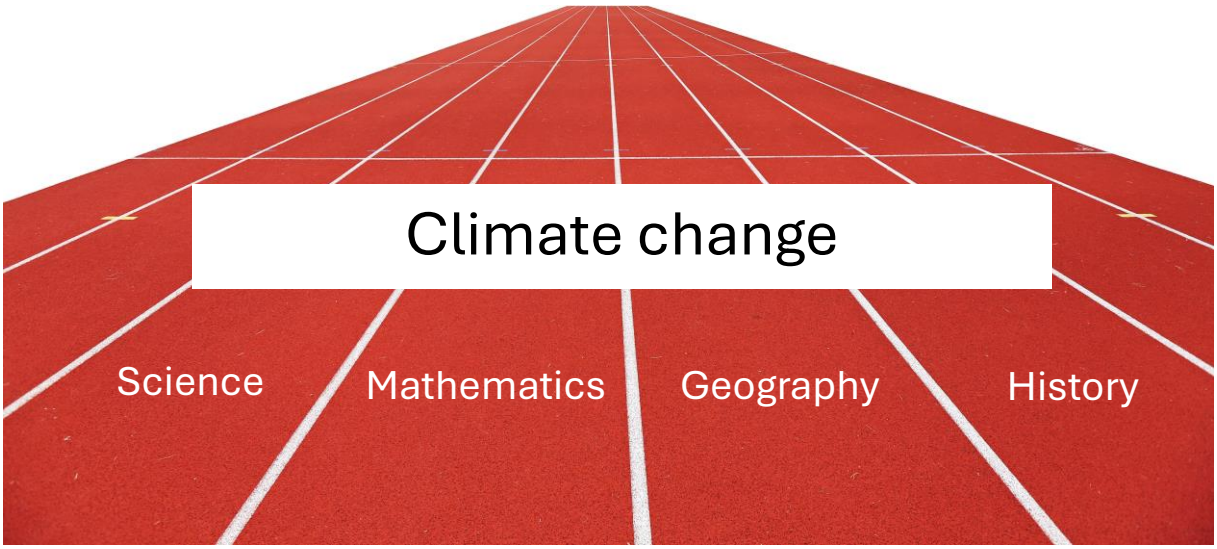

Figure 13. A phenomenon unites multiple disciplines into a holistic and authentic learning entity

A well-designed PhBL project on climate change and environmental protection should aim to achieve a range of relevant content and skill-specific learning outcomes. By incorporating knowledge, skills, attitudes, and behaviours related to climate change and environmental protection into teaching, educators can empower learners to become informed, responsible, and engaged citizens who are equipped to address the various environmental challenges present in our time.

Case studies and examples

Case examples – primary and lower secondary education (1st-9th grades)

To illustrate the applications of PhBL, this chapter includes case examples from different educational contexts. The grade levels presented in this chapter are based on those of Finland's education system (see e.g., Finnish National Agency for Education, 2025). The case examples demonstrate how PhBL can be applied in the thematic context of climate change, environmental protection, and sustainable development across various educational levels, from primary to higher education.

Primary Education Case Example 1: Explore – Root causes

Grade Level: 4.-9.

Subject Areas: adaptable to many subjects

Phenomenon: sustainable development

Recommended duration: adaptable

Reference: Translated and adapted from: Lauttamäki, E., Lehtinen, R., Rajala, A., Rentola, A., & Rauhankasvatusinstituutti ry. (2020). Opettajan Opas—Agenda 2030 teemapäivät. Rauhankasvatusinstituutti ry.

https://cdn.accentuate.io/4483793092659/11692919193651/Agenda-2030-teemap%C3%A4iv%C3%A4opas_lz4yr5Z-v1585637871656.pdf

Objective:

In this exercise, students will investigate the root causes of a particular issue. By understanding the background of the phenomenon thoroughly, they can think in a more informed manner about solutions to change it. (Lauttamäki et al., 2020)

Instructions:

Step 1: Introduction: Define necessary terminology (cause, consequence, sustainable development etc.)

Start by watching the video The largest lesson (available in Spanish/Bulgarian) on the United Nation's Sustainable Development Goals.

Ask students to pay attention to the challenges associated with implementing sustainable development.

Together, list on the board the types of challenges mentioned in the video.

Step 2: Group work

Divide students into small groups. Ask each group to choose one challenge from the board or think of another challenge or issue that everyone in the group recognises and wants to address.

Step 3: Tree diagram

Each small group receives one A3 or A2-sized paper, markers, and sticky notes. On the paper, draw a large tree trunk with roots, trunk, and branches. The group writes their chosen issue on the tree trunk. This exercise can also be done using visualisation and collaboration tools, such as Padlet, Flinga, or Prezi.

Step 4: Roots and branches

The group discusses and writes the causes and consequences related to the issue on sticky notes, using different colours for causes and consequences. Attach the causes to the tree roots and the consequences to the branches. Encourage students to think about the underlying causes of the problems. For example, the lack of clean water may be due to drought, which is caused by climate change, in turn caused by human actions, and so on. These deeper causes can be traced further back to the roots to identify the ultimate root causes of

the problems. Does any consequence loop back to the causes, creating a negative cycle?

Step 5: Presentation

Small groups present their completed tree to other groups. Other groups comment and ask questions, and groups modify their tree based on the feedback.

Step 6: Information gathering

Groups search for additional information from various sources to gain a deeper understanding of the phenomenon and its underlying causes. The group adds new ideas to the tree based on the information they find.

Interviewing experts: At this stage, information gathering can be supplemented by interviewing experts via phone, email, or face-to-face. Students discuss with the rest of the group and teachers who they can interview to get more information about the phenomenon. First, clarify who or what could be experts on the phenomenon and how to contact them.

When there is a lot of information about the phenomenon, the group presents ideas on the best ways to address the situation and resolve the problem. Experts can also be asked for advice on how to address the issue. Is anyone already doing something about it? How can young people influence the phenomenon or draw attention to it? What means of influence could be utilised?

The work can continue with exercises like *"Make a difference: Making dreams come true"* or *"Make a difference: If I could decide…".*

Step 7: From idea to action

Next, small groups create a plan on how to implement the idea.

EXTRA: Follow-up exercise: make a difference: making dreams come true

Objective: With this follow-up exercise, students can continue the "Root causes" exercise in groups. In this exercise, students brainstorm solutions to problems and practice civic engagement skills.

Step 1: Dream map

Ask students to create a dream map where they envision what the world would look like if the issue from the "Root causes" exercise was resolved. Guiding questions: What good would come from resolving the issue? How would people, nature, and the economy benefit? List the good things that would lead to other good things.

Then, review the tree created in the "Root causes" exercise. What needs to change in the tree for the positive dream to be possible? List the change requirements.

Step 2: Brainstorming

Next, students brainstorm various and diverse ways to bring about change and achieve a positive outcome. Encourage students to think boldly and creatively and have them list as many ideas as possible without censoring them at this stage.

Step 3: Filtering

Once the ideas are listed, ask students to examine the ideas critically:

- Does the idea address the root causes of the problem?
- Would the idea cause problems elsewhere?
- Does the idea consider the people affected by the problem and its solution?
- Could the idea bring about the desired change?
- Could success be evaluated? How?
- Is the idea feasible? Why? Why not?
- Ask groups to then choose one strong solution from their list.

Step 4: Planning

Guiding questions for creating the plan:

Scope: At what level do you want to implement your plan: individual level, local environment, your own country, Europe, the world?

People: Who needs to be involved as an expert, to implement, to support, to hear about the plan?

How: By what means will the plan be implemented?

Finally, ask students to consider whether the plan is realistic and impactful.

Challenges: What challenges might arise in implementing the plan? How could the challenges be resolved?

Evaluation: How can the implementation be evaluated?

Step 5: Getting Everyone Involved!

Ask learners to prepare a presentation of your action plan for the rest of the class. The goal of the presentation is to get everyone excited about their plan.

In the presentation, tell in your chosen way the following:

- What kind of world do you dream of: "If only we had a world where…"
- What problem have you come up with a solution for: "But unfortunately, the problem is…"
- What kind of action have you planned: "However, we can change the world like this…"
- How others can participate in the campaign and why they should participate: "And you can join too…"

The presentation can be in any form: a video presentation (e.g., vlog), spoken narration, mini-play, story, social advertisement, audio play, or wall comic, and it can include, for example, a participatory mini-quiz, challenge or guessing game, petition, or even a citizens' initiative.

Finally, discuss together with the whole class:

- What means did you use to get others excited about your action plan?
- What kind of presentations did you get involved in?
- How can knowledge and understanding of the issue and increased empathy change the world?
- What increased the credibility of the action plan?

Primary Education Case example 2: Spread the Good – Sustainable lifestyle

Grade Level: lower secondary education (7.-9. grades)

Subject Areas: adaptable to many subjects

Phenomenon: Spreading the Good - Sustainable Lifestyle

Recommended duration: 3 school days

Reference: Niemi, L.-M., Lehtovaara, K., & Hietikko, J. (2015). Monialaisia oppimiskokonaisuuksia yläkoulussa. In H. Cantell (Ed.), Näin rakennat monialaisia oppimiskokonaisuuksia. PS-kustannus.

During the years 2012-2013, Kasavuori Lower Secondary School implemented the "Spread the Good" project. The purpose of the project was to spread good and kind deeds in their local environment. The goal of the project was to promote students' engagement in future-oriented and sustainable ways of thinking and acting. The project aimed to provide a learning experience for learners in developing solutions that are ecologically, economically, socially, and culturally sustainable. In the project, students were guided to form groups of two or three people, comprising members from their own class or other classes. Each group created a plan on how to spread good in their local environment and implemented it. The plans were executed during project days during the autumn and spring semesters and documented. The resulting final products were presented to other students. (Niemi et al., 2015)

The project consisted of initial planning and workshop days. The initial planning phase was conducted during the homeroom/form teacher's (in Finnish lower secondary education, this person is responsible for supervising a class) lesson. The learners were introduced to the general idea of the project, and ideas were gathered from the students on what "Spread the Good" means. In the following sessions, the groups' topics were elaborated, and learners were assigned to a group facilitated by a supervising teacher. At the end of the planning phase, groups and teachers also arranged the visits and other practical matters for the workshop days.

During the workshop days, students did not have regular lessons to attend but worked solely on their projects. Other teachers substituted for teachers supervising the groups during the workshop days. The supervising teacher team had divided the organising tasks amongst themselves. These tasks included ensuring that student groups were provided with relevant learning tools, such as computers, taking responsibility for room reservations, and informing the work community and parents about the workshop days.

Workshop days program

First Day

Morning: Learners created a written plan for their project and started preparing the activities

Afternoon: Learners continued to prepare the activities, gathered key materials for their activities, and documented their learning process at a preferred location, e.g., school or outside school

Second day

Morning: Learners implemented their planned activities of spreading good outside the school. Moreover, groups conducted documentation on their work at school.

Afternoon: The groups continued documenting their activities and started creating the final product

Third day

Morning: Learners conducted documentation, completed the final product, and practised the upcoming presentations.

Afternoon: Group presentations were held first within the working group and then for the classes of the grade level.

In the implementation phase, learners spread good in various ways. Their activities included, for instance, shovelling snow from neighbours' yards, preparing recycling and waste sorting signs for the school, attending elementary school lessons as assistants and organising exercise sessions at an elderly people's home.

Students were encouraged to document their work in various ways. For this, many students preferred videos and slide presentations. For documentation, learners were allowed to use their own mobile devices to take videos and photos. Students had the opportunity to bring their own digital devices to school for editing purposes. Moreover, they were also assigned homework to edit and finalise their outputs.

Project evaluation

Evaluation was discussed before the activities began. The evaluation of the work was conducted through the supervising teacher's evaluation of the overall work, the groups' self-assessments and teacher-instructed peer-assessments between the groups. After the project, the supervising teacher and the group participated in a discussion to evaluate their work. The evaluation examined various elements of the learning process, such as the overall quality of their work, final products, oral presentations, written plans, scheduling, division of labour within groups, and collaboration in online groups and during the implementation phase.

The project's final evaluation was considered in the evaluation of two subjects. For this, learners were allowed to select which two subjects they wanted to include in the project's evaluation. They could select one subject from art and physical education and one academic

subject. The evaluation results for each subject were shared with the respective subject teachers. A summary of the evaluation was communicated to the learners' guardians.

Case Examples – Secondary and Higher education

Secondary Education Case Example: Climate change

Grade Level: upper secondary education and vocational education

Subject Area: e.g. biology and geography, visual arts, social studies, languages, music, and philosophy.

Phenomenon: Climate change

References: Translated and adapted from

- United Nations Association of Finland and Lindholm, M. (2022) Ilmastonmuutos - ilmiöprojekti. https://www.ykliitto.fi/kasvattajille/yk-osaksi-opetusta/tehtavat/ilmastonmuutos-ilmioprojekti
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teemapäivät. Rauhankasvatusinstituutti ry. https://cdn.accentuate.io/4483793092659/11692919193651/Agenda-2030-teemap%C3%A4iv%C3%A4opas_Iz4yr5Z-v1585637871656.pdf

- Familiarize Yourself: Young Climate Influencers:

Lauttamäki, E., Lehtinen, R., Rajala, A., Rentola, A., & Rauhankasvatusinstituutti ry. (2020). Opettajan Opas—Agenda 2030 teemapäivät. Rauhankasvatusinstituutti ry. https://cdn.accentuate.io/4483793092659/11692919193651/Agenda-2030-teemap%C3%A4iv%C3%A4opas_Iz4yr5Z-v1585637871656.pdf

What is learned?

The phenomenon-based project focuses on climate change and culminates in a collage poetry workshop and poetry art exhibition. Agenda 2030 Goal 13: Climate Action is closely related to the topic. The project offers a deep understanding of climate change and related topics, and provides tools for considering the subject and the climate actions we can take ourselves. (United Nations Association of Finland & Lindholm, 2022)

Target group: upper secondary (vocational education)

Duration: 5 ECTS / approximately 3-4 months, autumn or spring semester

Materials and guests: Climate action materials, Agenda 2030 goals, an expert guest speaker, suitable music, and websites of various related organizations

Number of participants: students and teachers from five different subjects (see further details below under Subjects)

Description of the project

The project's goal is to learn about complex phenomena in a meaningful and experiential way, understanding the related contexts and connections to one's future profession. It is a multidisciplinary learning module, conducted in collaboration with teachers from various subjects.

Learning is action-oriented, utilising multiple environments and methods, such as outdoor learning, individual, and group work. Learning is also participatory, with learners playing a key role in various stages of the project. The approach is learner centred.

Content of the phenomenon project:

1. Introduction and orientation to the topic (40-50 hours)
2. Project planning (1-2 hours)
3. In-depth exploration of the topic (30-40 hours)
4. Collage poetry workshop (2-3 hours)
5. Project conclusion: final exhibition (20-30 hours)
6. Optional: Song campaign (5-10 hours)

Subjects in vocational basic education

The project can be tailored for the common units of vocational basic education as follows (common units include a total of 35 credits, 26 compulsory and 9 optional):

1. Communication and interaction skills; art and creative expression (1 credit for the project)
2. Social and work-life skills: maintaining work ability and well-being (total 2 credits, 1 credit for the project)
3. Acting in society and as a citizen (total 2 credits, 1 credit for the project)
4. Promoting sustainable development (1 credit for the project).
5. In addition: Communication and interaction in a foreign language (total 3 credits, 1 credit for the project)

= 5-credit module (approx. 135 hours).

Subjects in upper secondary school

In upper secondary school, an interdisciplinary project can be implemented according to the model above in subjects such as biology and geography, visual arts, social studies, languages, music, and philosophy.

Instructions for tasks

Each part of the project includes various tasks with detailed instructions and descriptions, as outlined below (individual and group tasks). Learning environments vary, and students can also influence the selection and implementation of certain tasks.

Implementation of the Phenomenon-based project

The multidisciplinary phenomenon-based project focuses on climate change, which is examined from different perspectives. Throughout the project, students engage in diverse, functional, and participatory tasks related to the subject. As the final output, a collage poetry workshop and exhibition will be presented.

1. Introduction and orientation to the topic (40-50 hours)

Preliminary assignment before the first classroom activity:

- Read the detailed description of Goal 13: Climate Action from the Agenda 2030 (The Global Goals, 2025). Material is also available in Spanish.
- Questions to think about:
  - How does climate change manifest in our country and elsewhere?
  - What thoughts arise regarding your future field and profession?

Classroom activity:

- In the class, discuss the thoughts and responses generated by the preliminary assignment with the group.
- Discussion of the questions given in the preliminary assignment:
  - How does climate change manifest in our country and elsewhere?
  - What thoughts arise regarding your future field and profession?
- This can also be conducted as a language immersion activity if a foreign language is involved. In this case, the goal is to read in the targeted foreign language, and the class discussion is conducted in the same language.

Homework:

- Independently explore concepts/topics such as:

- Global warming
- Climate refugees
- Climate anxiety and climate hope (provide examples of relevant websites in your own language. In Finnish, helpful information can be found on sites like ympäristö.fi, ilmatieteenlaitos.fi, and ilmasto-opas.fi).

- Familiarise yourself with signs of change via videos and visualisations. Examples of websites:
  - Climate guide's videos and IPCC infographics:
    - https://www.climateguide.fi/videos-climate-change-as-a-phenomenon/
    - https://www.climateguide.fi/ipcc-infographics/

Class activity:

- What prevents us from acting to mitigate climate change?
- Listen to an expert speech about the topic and read an article. An example of an article, "What prevents us from taking action to mitigate climate change?" in Finnish: https://www.sitra.fi/en/articles/prevents-us-taking-action-mitigate-climate-change/
- Have discussions with the group based on the expert speech and the article

Class activity:

- Create a collective idea map on solutions to mitigate climate change.
- Consider what solutions can be implemented in your future profession to mitigate climate change.

Homework/Class activity:

- Quiz on climate change. An example of a quiz can be found here (in Finnish): https://openilmasto-opas.fi/faktat-kuntoon-ilmastosta-testi/

Pair activity:

Explore: Climate action (Exercise 26 in Lauttamäki et al., 2020)

- Investigate different phenomena, causes, and consequences of climate change. Create a mind map or other type of report on the topics in pairs or small groups. Divide the students into pairs or small groups. Assign each group one or two concepts from the list found in the online learning materials. Create a concept map on large paper about the group's concept(s):
  - Causes: What causes the phenomenon [concept] in your group? What has caused it? What are the factors that exacerbate it?
  - Consequences: What are the consequences of the phenomenon in your group? Who does it particularly affect?
  - Influencing: How can the phenomenon be influenced and promote the fight against climate change? How can anyone influence it?
  - Influencers: Who can impact the problem? How? Gather the concept maps together and present them to each other.

Individual or pair activity:

Familiarize yourself: young climate influencers (Exercise 21 in Lauttamäki et al., 2020)

- Familiarise yourself with young climate influencers. Create comics about their activism.
- For example, watch the video of climate activist Greta Thunberg's speech at the UN summit in September 2019.
- Investigate who typically attends the United Nations summit.
- Also, familiarise yourself with the following young climate influencers: Autumn Peltier, [14 yrs.] Isra Hirsi [16 yrs.], Xiuhtezcatl Martinez [18 yrs.]. You can find information about them by searching the internet, their own social media channels, and YouTube.
- Choose one of the four young influencers. Draw a short comic about the young climate influencer's life, describing how they decided to get involved in advocating for an important issue to advance the fight against climate change and how they influence it.

Small group activity:

Positive environment or climate news in media (Miettinen & Happonen, 2025b)

- Search for positive climate news in the press and on social media. A good news headline might relate to legislation or efforts to slow climate change.
- Consider which news stories pertain to your future field and profession.
- At the same time, reflect on what kinds of headlines attract attention and why the media tends to emphasise mostly provocative and negative news.
- We know that people often click on and share primarily troubling or anger-inducing news on social media. Why does this happen?
- After searching and discussing, cut out headlines from printed newspapers and paste them onto separate sheets of paper.
- "Clippings" from digital news channels can be made using screenshots. Screenshots can be compiled on the same page using image editing, layout, or word processing software.
- Everyone should aim to find 3-5 headlines.
- Spend 15-20 minutes searching for headlines.
- Finally, review the headlines together. Was it easy or difficult to find positive climate news? Why?

Next project session:

- In a small group of students, select 2-3 news items and write them on large papers, which are then attached to the classroom wall.
- The group should familiarise itself with all the news, serving as a thought-provoking activity.
- Groups select a chairperson to present the selected news headlines to an expert later in the project.
- The chairperson can also briefly prepare a justification for why the news was chosen and why it was considered important by the group.

2. Project planning (1-2 hours)

Class activity:

- In small groups, familiarise yourself with the collage poetry workshop assignment instructions (see step 4) and list the necessary equipment.
- Plan the implementation of the workshop.
- You can set the mood for planning with music on the topic of climate change.

3. In-depth exploration of the topic (30-40 hours)

Pair activity:

Consequences of climate change

- Familiarise yourself with the following materials and then discuss these questions with your partner:
  - First, look for resources on the environmental impact of food on the internet
  - How does increasing vegetarianism affect the climate and its temperature?
  - How does reducing the use of animal products affect nutrition?
  - Write your favourite vegetarian dishes on the board and challenge each other to eat/prepare each other's favourite vegetarian dishes.

Class activity:

- Familiarise yourself with Earth Hour Day (e.g., from WWF's website).
- Plan a short information session on the topic and agree on how the day will be celebrated within your group (e.g., turning off lights at school or home for an hour, participating in an energy-saving week, hosting information sessions via the school radio, organising yard events, or demonstrations).

Class activity:

- Watch the documentary "An Inconvenient Truth" (2006, USA), which addresses global warming. In the documentary, former US Vice President Al Gore presents climate change and its estimated impacts. The film won two Oscars in 2007 for Best Documentary Feature and Best Original Song. The film has also sparked typical controversy on the subject.
- After watching the film, complete the tasks "Melting Glaciers" and "Impacts of Climate Change" from the site: https://www.koulukino.fi/oppimateriaalit/epamiellyttava-totuus/miten-voit-itse-vaikuttaa/
- Write down observations or questions from the film and the tasks for the upcoming visitor.
- This can also be conducted as a language immersion activity if a foreign language is involved. In this case, the film's subtitles are chosen in the selected foreign language. If the target language is English, subtitles are not used. As a learning task, observations and questions are written in the selected foreign language.

Climate change expert/organisation representative visit:

- The visit is intended to be interactive and conversational (can be held outdoors depending on the weather, with questions brought along).
- After the expert's informal introduction, group chairpersons present selected questions and news headlines that were previously posted on the classroom wall and emerged in the previous step. For example: "The use of renewable energy has exploded (news) --> How can we influence global warming?"

Pair activity:

Task for biodiversity day: climate refugees (United Nations Association of Finland, 2025)

- To spark interest, watch a video that exemplifies the links between climate change, security, and refugees in your preferred language.

- Divide into pairs. Conduct a pair discussion on three concepts. Initially, no prior knowledge is needed as the purpose of the discussion is to warm up to the task. Discuss the concepts in this order:
  - Climate
  - Refugees
  - Climate refugees

- After the pair discussion, divide learners into groups of four. In your groups, start searching for information on climate refugees. Use the internet and social media channels to gather information. Write down your findings and observations. You can write your reflections either on paper or on a computer, for example, in the form of a PowerPoint presentation. Write at least:
  - What does climate refugee mean?
  - Who can become a climate refugee?
  - How are climate refugees discussed on social media? Is the discussion different on different channels?
  - Will the number of climate refugees increase in the future?
- Finally, present your reflections to the rest of the class.

Class activity:

- Play climate bingo.
- Climate bingo helps learn and review key concepts related to climate change and its consequences.
- An example of climate bingo in the MAPPA.fi material bank (includes forms and templates in Finnish. You can use e.g. browser-based translation tools to translate the instructions and templates into the preferred language).
- This exercise can also be conducted as a language immersion activity if a foreign language is involved. In this case, in addition to playing climate bingo, the concepts are translated into a foreign language.

4. Collage poetry workshop (2-3 hours)

Organise a climate and environment-themed collage poetry workshop (Miettinen & Happonen, 2025a)

For the collage poetry workshop, you will need sufficient materials, such as magazines, newspapers, and other text materials for cutting, as well as scissors and glue sticks. Additionally, you will need paper or cardboard to which the finished poem will be glued. Another way to preserve the poems is to take a picture of them and save them, for example, in a shared folder. Pictures of the finished poems can also be shared on social media.

Working process

Begin by collecting suitable materials, i.e., cutting out topic-related words from magazines. It is often convenient to choose words from headlines or other sufficiently large, printed words. You can also use smaller printed text, but it is more difficult to handle and paste. Try to collect 15-20 words initially by making relatively quick selections. Words from all word classes (adjectives, verbs, nouns) are needed to build new sentences. Once you have a suitable number of words, start seeing how they fit together. Often, the poem begins to "write itself," meaning certain words seem to fit together and start forming sentences. At this stage, missing connecting words and sentence parts are often needed to make the sentences understandable. These can be found or asked for from a neighbour. Missing words can also be constructed letter by letter.

Images

Collage poetry can also use image material. Sometimes, a compelling full-page image can be found in a magazine, which can serve as the base for the poem, with words pasted on top. Images can also be combined by pasting them together.

Content of the poem

There are no specific rules regarding the content of the poem. You can also use ready-made sentences as part of the poem, but the most surprising and rewarding result is achieved when sentences are built word by word. Use news text, entertainment text, advertising slogans, and consider what the source text was written for. The purpose of the source material determines the type of vocabulary used. News vocabulary is very different from that used in,

for example, a youth magazine or hobby magazine. Mix different language registers together. It helps to identify suitable opening and closing sentences to understand the overall structure. One way is to choose the beginning and end of the poem, paste them first, and then build the middle part. The poem can be short and aphoristic or longer, like prose poetry. It can be funny, sad, absurd, or straightforward. It can be list-like or more lyrical if it provokes thoughts. Allocate 20-30 minutes for cutting and pasting the poem.

Finishing up

The poems are read aloud. This can be done by the teacher or volunteers participating in the workshop. Finished collage poems can be made into an "art exhibition." The works become more impactful when enlarged, for example, to A3 size. Finished poems can also be written cleanly, where the collage technique is lost, but the assembled poems become "real poetry." This way, you can consider different poetry techniques and the pros and cons of the collage technique. No one would likely come up with similar word combinations if faced with a blank page. Start cutting and pasting!

For the collage poetry workshop, you will need sufficient materials, such as magazines, newspapers, and other text materials for cutting, as well as scissors and glue sticks. Additionally, you will need paper or cardboard to which the finished poem will be glued. Another way to preserve the poems is to take a picture of them and save them, for example, in a shared folder. Pictures of the finished poems can also be shared on social media.

5. Project conclusion: final exhibition (20-30 hours)

Organizing the final exhibition:

- Visiting the exhibition of the poetry works: other classes, school staff, parents.
- Agree on responsibilities within the group (e.g., enlarging and displaying exhibition works, adding works to social media and websites, and invitations to the exhibition).

- Comics created in step 1, as well as positive and negative climate news, are also displayed in the exhibition, and images of them (as well as poetry works) are added to the school's website and social media pages.
- Background music for the exhibition can be compiled from songs related to or about climate change (see song campaign).

6. Optional: song campaign (5-10 hours)

Organise a song campaign:

- Compile a list of songs related to or about climate change.
- Use the songs as background music during exercises, in the final exhibition, or as part of the campaign to raise awareness about climate change.

Higher Education Case Example: Phenomenon-based pedagogical model

Grade Level: higher education

Subject Area: adaptable to many study programs in higher education

Reference: Auno, P., Heikkinen, E., Itkonen, H., Karhu, A., Karjalainen, R.-L., Korkealehto, K., Määttä, A., Oikarinen, A., Rajander, T., Ravelin, T., Ruotsalainen, M., & Takala, K. (2016). Pedagoginen malli 2016 – älyllä ja ilolla osaajaksi. Kajaanin Ammattikorkeakoulun Julkaisusarja B 54 / 2016. https://www.theseus.fi/handle/10024/107179

Kajaani University of Applied Sciences presents a phenomenon-based pedagogical model applied to higher education. This case example illustrates how phenomenon-based learning has been integrated into competence development across various study programs. The pedagogic approach is centred around holistic and real-world phenomena. Learning through phenomena happens in authentic and interdisciplinary contexts. The model emphasises interdisciplinary learning between study programs and students acquiring knowledge, skills and attitudes through assignments from the working life. (Auno et al., 2016)

In this model, learning is based on the socio-constructivist approach, which views learning as an essentially active and team-oriented process that occurs when people collaborate to solve problems and work towards common goals. In this process, learners acquire competences by taking responsibility for their own learning and being actively involved in knowledge building and meaning-making in real-world working contexts. A teacher's role is to facilitate and guide this student-centred learning process. The model also underlines collaboration between teachers and other expert services. In this approach, teachers collaborate to implement team teaching with other teachers and experts to support learning. For example, librarians and project personnel provide their expertise to support learning.

In terms of learning methods and environments, the primary mode of instruction is blended learning, which means learning is organised partly in class and partly remotely. The learning programs focus on community-based learning. Students are provided with personalised learning paths. Learning methodologies include, for example, inquiry-based learning, project-based learning, portfolio-based learning, and game-based pedagogy. Learning tasks are derived from phenomena and questions arising from working life. For phenomena requiring multidisciplinary expertise, students collaborate in multidisciplinary teams. Along the lines of phenomenon-based learning, learning occurs in versatile learning environments, such as classrooms and innovative learning environments. A key aspect of these environments is that they work as meeting spots for students, personnel and stakeholders, such as companies. For example, stakeholders may be invited into learning environments as guest lecturers. Through these diverse learning environments, students encounter new situations and acquire new ideas and insights in dialogue with the environment.

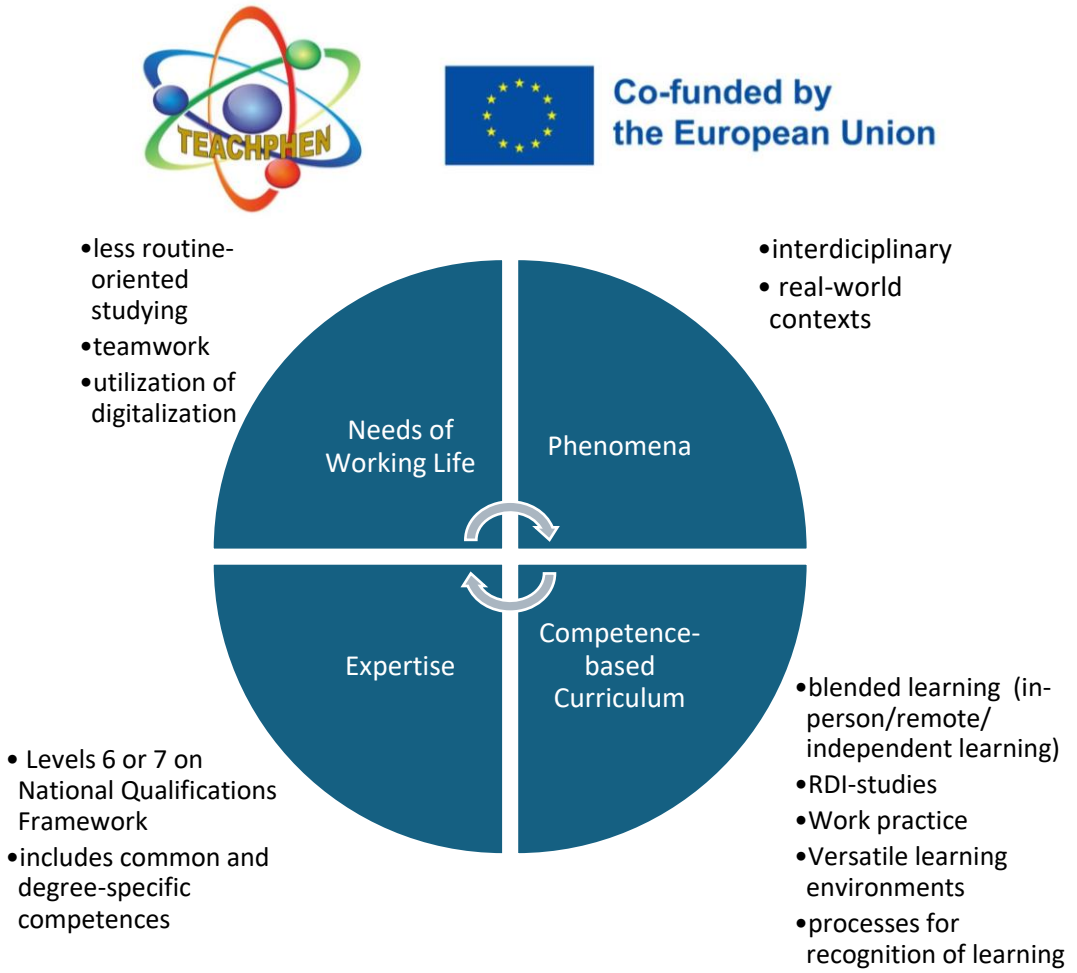

Figure 14. Phenomenon-based learning in Kajaani University of Applied Sciences. Translated from Auno et al., (2016).

Adapting Phenomenon-Based learning for inclusivity and technological integration

This chapter outlines the key information for planning and instructing a PhBL project tailored to support learners with mild learning disabilities and special needs. From this perspective, it provides strategies for enhancing inclusivity, accessibility and technology integration of a PhBL project.

Adapting Phenomenon-based learning for learners with special needs

Adapting Phenomenon-Based Learning to your specific context involving learners with special needs requires knowledge of your learners' special needs and the methodology to address those needs. As we know, learners with special educational needs and disabilities (SEND) are individuals who have learning difficulties or disabilities. These difficulties can create physical, cognitive, emotional, or sensory challenges in learning and limit learners' ability to make progress in education (Herwegen, 2024). Learning difficulties can be caused by, for example, developmental disabilities, neurological diseases, injuries, or mental health issues (Oppimisvaikeus.fi, 2025).

Learning difficulties and disabilities are relatively common worldwide, and it has been assessed that up to 20 per cent of the population experiences some kind of difficulties with learning. These challenges can be narrow and affect only one area of learning. Often, they also co-occur. They may also occur at varying degrees of severity. (Hämäläinen et al., 2015)

According to Hämäläinen et al. (2015), the common types of learning difficulties and disabilities include, e.g.:

Dyslexia

Dyslexia is a set of processing difficulties that affect the acquisition of reading and spelling. Signs of dyslexia include difficulties with reading and reading comprehension, writing, learning foreign languages, and mathematics. Linguistic challenges in reading may appear as

difficulties in perceiving lines and letters in text or having a slow pace in reading. In writing, learners may struggle with producing coherent text and maintaining accurate spelling. Dyslexia may also cause problems with learning foreign languages. These problems may manifest as difficulties in learning spelling, vocabulary or sentence structures. Dyslexia commonly co-occurs with mathematical difficulties. This may be evident, for example, in difficulties of understanding word problems or learning multiplication tables aloud. (Hämäläinen et al., 2015) Dyslexia may also limit the capacity of a person's short-term memory. This may show up as difficulties in remembering oral instructions or complex thought structures, as well as executing complex problem-solving (Oppimisvaikeus.fi, 2025). Frequently reported strengths of dyslexic learners include visual perception, holistic thinking, ingenuity and artistic talent. (Hämäläinen et al., 2015)

Mathematical learning difficulties and Dyscalculia

Mathematical learning difficulties manifest as challenges in learning mathematics as a subject and limited mathematical information processing in everyday life. Mathematical learning difficulties can be classified into two categories: dyscalculia and poor proficiency in mathematics. In dyscalculia, difficulties in mathematics affect learning significantly and may be evident in learning, for example, basic arithmetic skills, number sequence skills, understanding mathematical symbols or measurement units. In everyday life, handling money may be challenging. (Hämäläinen et al., 2015)

Attention Deficit Hyperactivity Disorder (ADHD)

Symptoms of ADHD may involve trouble focusing or staying organized, short attention span, carelessness in school assignments, poor time management, problems with remembering the location of personal belongings, forgetting meetings, impulsivity, talkativeness or getting stuck with things that interest them. However, persons with ADHD often have many strengths and they may be ingenious, imaginative, curious, quick-witted, energetic, creative and enthusiastic. (Hämäläinen et al., 2015)

Perceptual difficulties

These are issues with correctly interpreting stimuli from the environment or the body. Difficulties can show in interpreting visual or auditory information. Problems with visual interpretation can involve differentiating visually between similarly looking letters or recognizing the direction of letters or numbers. Challenges with auditive perception may cause difficulties with distinguishing similarly sounding words from each other. Perception difficulties may also manifest as difficulties in understanding and interpreting time or the surrounding space, such as problems with reading schedules and maps, and assessing directions, distances, or locations of objects. (Hämäläinen et al., 2015)

To help learners overcome various obstacles in their learning, it is essential to enhance the accessibility of education and integrate inclusive, strengths-based approaches into teaching (Herwegen, 2024). Strength-based approaches often emphasise the following dimensions in planning education: 1) identification of strengths, 2) agency and self-determination, and 3) growth mindset (Hodges & Clifton, 2004). As an example of a strength-based educational approach, Universal Design for Learning (CAST, 2025) can be utilised to plan teaching and assessment that aims to support learners with their difficulties and highlight their strengths throughout the learning process.

Universal Design for Learning and Assessment

Universal Design for Learning (UDL) is an educational approach designed to make education more accessible by accommodating the diverse needs, abilities and strengths of all learners. This approach is based on recent developments in neuroscience related to learning, and it is founded on acknowledging neurodiversity among learners. (CAST, 2018)

For a teacher, the purpose of UDL is to support the entire process of planning, teaching, and assessment to improve the accessibility of learning for all learners. It helps teachers develop and deliver more adaptable education, address the needs of various individuals, and remove obstacles to learning through effective design and planning. As a primary focus, UDL seeks to strengthen learners' agency, which refers to the ability to make active, reflective and

purposeful choices that facilitate achieving learning objectives. To enable this, the teacher's role is to facilitate the learning process by providing learners with individual and collective spaces for reflection and collaboration to gain a deeper understanding of the topic being learned. (CAST, 2025)

The UDL framework is built on three principles to increase the accessibility of teaching and eliminate barriers to learning. (CAST, 2025) According to neuroscience, effective learning can be promoted through pedagogical design that activates the key parts of brain that are responsible for processing information. These include the areas responsible for perceiving sensory input (the "what of learning"), understanding and organizing that input (the "how of learning"), and motivating and engaging learners (the "why of learning"). (CAST, 2018)

UDL addresses this through three pedagogical design principles. These principles guide teachers in enriching their teaching by providing 1) multiple means of engagement, 2) multiple means of representation, and 3) multiple means of action and expression.

The Principle 1: Provide multiple means of engagement

Engaging learners in learning requires acknowledging their diverse identities, motivations and preferences. This can be addressed by 1) welcoming interests and identities, 2) sustaining effort and persistence, and 3) leveraging learners' emotional capacity for learning. (CAST, 2025)

Making a PhBL project engaging for learners requires addressing the diverse needs that drive engagement. Firstly, it is important to offer learners autonomy and choice in selecting the phenomena that resonate with their interests and cultural backgrounds. The teacher can provide a list of potential phenomena and let learners form groups based on their interests. Additionally, engagement can be supported by allowing students to conduct interviews with community members, gather local data, and present their findings in a manner that highlights their relevance to learners' own lives. This personal relevancy gives learners more agency and ownership in their learning. Secondly, it supports engagement by providing learners with the opportunity to learn through collaboration as they investigate phenomena in groups. This allows them to share perspectives. Thirdly, enhancing persistence and self-regulation in

learning can be achieved by establishing clear objectives and offering consistent feedback throughout the learning process. For example, checklists and rubrics help learners plan and monitor their progress.

Principle 2: Provide multiple means of representation.

Learners present diverse ways of perceiving, understanding and interpreting information. Learning and transferring knowledge occur most effectively when incorporating multiple representations and perspectives, as they enable learners to connect concepts. Generally, no single representation works for everyone. An individual's approach to and ability to make use of learning material can be affected by, for example, the presence of learning difficulties, such as dyslexia, or different cultural backgrounds. Thus, it is important to provide options to support 1) perception, 2) understanding of language and symbols, and 3) building knowledge. (CAST, 2025)

In a phenomenon-based project, multiple means of representation can be addressed in many ways. Diverse learning needs can be supported by utilising multimedia learning resources that combine text, images, videos, and interactive simulations to explain complex phenomena. For aiding comprehension, provide glossaries and visual aids. This can involve, for example, giving definitions for technical terms or using diagrams or concept maps to illustrate relationships. Also, graphic organisers, such as mind maps, can help learners to visualise, break down and organise information. Increasing representation can also involve offering a digital resource library where learners can access different types of content. For a topic on water systems and climate change, a library can involve, for instance, a video explaining the water cycle, an interactive simulation of weather patterns, and an article on the impact of water scarcity.

Also, assistive technologies can be helpful for increasing diversity for representation in teaching (CAST, 2025). These include devices and software that remove learning barriers. To support learners with dyslexia, text-to-speech tools enable learners to read written resources aloud. Examples of software include browser extensions, such as Read Aloud (Read Aloud, 2025), and freeware software like Balabolka (Morozov, 2025).

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Principle 3: Provide multiple means of Action and Expression

Learners vary in their approaches to learning environments and tasks, as well as their preferred strategies for learning and expressing the knowledge they have learned. Individuals have unique preferences; some may favour writing over speaking, or vice versa. Therefore, it is crucial to design a phenomenon-based project to cover diverse methods of action and expression.

In a phenomenon-based project, it is beneficial to provide learners multiple tools for constructing and expressing knowledge. Allow learners to use different materials, methods, tools and technologies to create their projects. To build 21st-century skills and make learning more relevant, it is recommended to involve options that are relevant to the context in which learners live. Currently, such options involve, for instance, artificial intelligence technology. At the final stage of the project, a teacher can offer a menu of options for presenting the output and let learners choose their preferred option. Options may include, e.g. written reports, presentations, models, and digital storytelling. Assistive technologies also provide diverse opportunities for action and expression.

Regarding assessment, action, and expression, clear and concise rubrics are provided that outline the specific criteria for evaluation. Formative assessment can be executed through scheduling regular check-ins with learners to support their learning process and provide feedback. Additionally, peer review sessions enable learners to provide and receive constructive feedback. For developing strategic thinking, it is important to provide scaffolded support for learning. This can initially include guidance and checklists to guide learners to plan and execute their projects. Then the support can be gradually reduced as learners become more skilled. (CAST, 2025)

Overall, the application of UDL has been found to be significantly effective when all three principles (rather than only one or two) are integrated simultaneously into teaching (Almeqdad et al., 2023).

Further information you may find in the free of charge course called: "Improvement of digitalisation competences of recent and future teachers by development of advanced training on instructional design of digital training" available at: https://course.instructional-design.eu/

Technology integration in Phenomenon-based learning projects

In phenomenon-based learning, teachers are encouraged to create engaging learning environments and explore new tools to foster learning. To support this, various technological tools can be integrated to enhance the learning experience in a phenomenon-based learning project. Examples of these include blogs that showcase the outputs of phenomenon projects and virtual learning environments. (Lonka et al., 2015). According to research, phenomenon-based learning can also be effectively implemented online (see e.g., Özevin, 2023; Somy Project, 2013)

With respect to 21st-century skills, PhBL is regarded as an effective method of teaching information and communications technology (ICT) skills (Wakil et al., 2019). Acknowledging ICT as both a societal phenomenon and a critical 21st-century skillset highlights its significance and supports its integration into the curriculum. (Finnish National Agency for Education, 2014).

In Finland, ICT skills are developed in schools in four main areas:

1. Learners are guided in understanding the main principles and central concepts, as well as developing their ICT skills while doing their own learning tasks.
2. Learners are informed about the responsible, secure and ethical use of ICT technology tools.
3. Learners are taught to use ICT technology tools for managing data, conducting research, and engaging in creative projects.
4. Learners gain experience and they practise using ICT tools for collaboration and networking.

According to Aarnio (2016), digital tools can be used in a PhBL learning process to support:

- **Expanding the scope of exploration beyond the limits of classroom:** digital tools can be taken out of the classroom to enhance learning in real environments. For example, learners can explore a real-world environment, such as a forest, with their digital devices to search for more knowledge or to document the phenomenon.
- **Information acquisition and processing:** digital tools can be used to acquire information and process it in various ways. To be able to find reliable information, it is crucial for learners to have skills in media literacy. Teachers can integrate the learning of these skills into their PhBL project.
- **Interaction and collaboration:** although face-to-face learning is regarded as the most effective way of learning in PhBL, digital tools can be used to facilitate learning by supporting communication during different phases of the process when learners are physically apart from their group. For instance, during the phases of self-study, learners can reach out to others working in the same group to ask for help via digital devices.
- **Documentation and reporting:** digital devices can be used to guide learners to document the phases of the learning process and deepen their skills in reflecting on learning. Digital tools also provide a means for reporting the output of the learning process through text, sound or video.

When teachers utilise technology in the learning environments, it is important to design it to be flexible and adaptable, and to support learners' agency and feelings of security and familiarity (Lonka et al., 2015). For example, grouping learners based on their ability levels allows the use of adaptive digital tools that provide tasks tailored to individual learning needs. This enables learners to progress through their work at their own pace. (Tynninen, 2024) To enhance motivation and interest in learning among digital natives (born after 1981), it is advisable to pay attention to the choice of digital knowledge practices, which encompass

personal, institutional, or social ways of using and creating knowledge. Thus, it is beneficial to adopt various methods of acquiring and producing information that already interest your learners as tools supporting the PhBL process. (Lonka, 2015)

Vaara (in Lonka, 2018b) gives some examples of the use of educational technology in a phenomenon-based learning process. In the activation phase, digital tools can help show real-life situations, for example, by using Mixed Reality (see e.g. Microsoft, 2023) or interesting videos. After that, mind mapping tools can help collect what learners already know and think about the topic. During the learning process, a digital platform could be beneficial for instructions, visualisation and collaboration. In the sharing and presenting stage, learners can use various digital tools to create presentations, produce videos, or write blog posts, which can then be shared with a broader audience.

Regarding the inclusivity of education, research indicates that technology facilitates the integration of Universal Design for Learning (UDL) principles in various ways, making teaching and learning more inclusive for all learners (Bray et al., 2023). Learners' diverse backgrounds and life situations typically require flexible learning options that support individual learning styles and time management. Thus, pre-class materials, the possibility to prepare and a sense of community also contribute to learning. Technology offers opportunities for greater diversity, but its effective use requires careful consideration of the learning environment, learner group, learning objectives and accessibility. (Kärpänen et al., 2023)

The integration of technology into teaching and learning depends largely on the availability of digital infrastructure and tools within each school, such as internet access, Wi-Fi networks, servers, and a reliable power supply. However, certain limitations must be considered, including the cost of digital tools and the common age restriction of 13 years for many online services that require user registration. Therefore, it is advisable to select applications that do not require learners to register in order to participate.

In the table below, there examples of digital tools and suggestions on how they can be used at different phases of inquiry-based learning in a phenomenon-based learning project (Luostarinen & Peltomaa, 2016; Venho, 2016).

Phase of Inquiry-based Learning	Digital tool examples	Purpose
1. **Orientation**	Mindmaps, Google search/docs, Kahoot, Wordwall, Quizlet, Socrative	brainstorming, planning, Introducing a phenomenon, concepts etc
	wordclouds: Answergarden, Wordart	tuning-in, mapping out phenomena
2. Conceptualisation	Google search/docs/slides	common understanding,
	Padlet/ Flinga board	gathering and evaluation of ideas
3. Investigation	Internet search, ChatGPT, Copilot, Gemini, Whatsapp	research, experimenting, Understanding, critical thinking collaboration
	Google forms	surveys, interviews
	DeepL	AI translation
	Read Aloud	converting text into spoken audio
4. Conclusion	Google slides	presenting and sharing the results
	Canva, Prezi, social media tools (Instagram, Facebook etc.)	presentation, picture collage
	Moodle's editor recording tool (audio/video), smartphone	audio/video material
	Blogger	creating blog texts that describe and illustrate the learning process and results
	Grammarly	proofreading

AI tools have, undoubtedly, revolutionized teaching and learning, and schools are seeking effective ways to guide learners in the responsible and critical use of artificial intelligence. This includes using AI to support deeper understanding, encourage creative thinking, and assist with language development. It is important to be aware of the guidelines of your school and country.

AI-powered tools provide versatile and invaluable support to learners with challenges such as dyslexia or ADHD. For example, text-to-speech and speech-to-text features aid those who struggle with reading or writing. Beyond that, AI can provide customised feedback and assistance tailored to various individual needs. Additionally, such tools with gamifying feature can make learning more interactive and motivating for learners who otherwise would disengage from learning in more traditional learning settings.

AI tools provide support for many pedagogical purposes. For structuring presentations and lessons, tools like Microsoft Copilot in PowerPoint are beneficial. The AI assistants ChatGPT and Microsoft Copilot are efficient tools for creating clear instructions. Proofreading and simplifying texts can be done with applications, such as Grammarly and ChatGPT. Tools like Microsoft Copilot and ChatGPT are helpful in summarising texts. For mathematical tasks, learners can utilise MathGPT and Math Solver. Finally, AI translation (see e.g. DeepL, 2025) and speech tools can be used to support language learning and communication in multilingual environments. (Annie Advisor, 2025).

Design of a plan for Phenomenon-based learning

This chapter incorporates practical instructions for planning an inclusive and accessible PhBL project, incorporating the principles of Universal Design for Learning, and provides a template for this planning process. Lonka (2018b) emphasises that, for a PhBL project, a pedagogical plan is essential for teachers to navigate the complex learning process of PhBL and for learners to understand their tasks and navigate their own learning.

The pedagogical planning process integrating UDL can be structured based on the Learning Design Wheel (Kärpänen et al., 2023). It includes the following six steps to execute the planning process:

1. Align your teaching objectives with the overarching goals of the organisation and ensure they are consistent with the national curriculum.
2. Identify the required skills and content knowledge and simplify the learning objectives while recognising potential barriers to learning.
3. Design assessments that allow learners to demonstrate their understanding in multiple ways. Communicate the expectations to your learners and use tools like rubrics to outline the skills and content knowledge required.
4. Select teaching methods that accommodate diverse learning needs. To maintain learner engagement, integrate flexibility and opportunities that allow learners to make choices. Offer continuous, consistent and well-timed support throughout the project.
5. Develop accessible and varied learning content and materials. Ensure that resources meet accessibility standards, such as providing captions for videos.
6. Evaluate the project critically, gather feedback from other teachers and learners and implement improvements where appropriate.

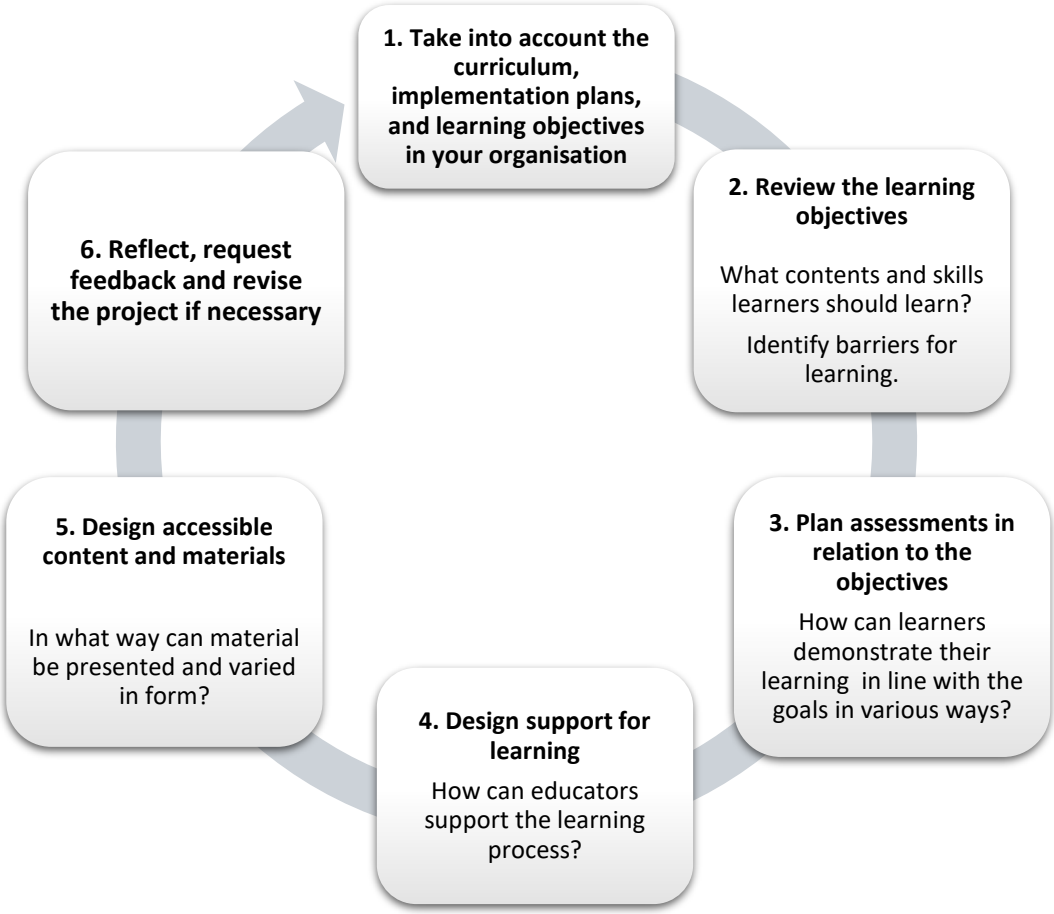

Figure 15. Learning Design Wheel model as a support for designing a PhBL project (translated and adapted from Kärpänen et al., 2023)

The following section provides a template for planning a UDL-based phenomenon-based project. The template incorporates perspectives from the learning design wheel, phenomenon-based learning, integrative and multidisciplinary learning, and universal design for learning. Each section of the template includes instructions for filling in the template.

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An Example of a Phenomenon-Based Project Plan

GENERAL INFORMATION	
Project's name	Sustainable ICT services
Phenomenon *Define the phenomenon(a) that is examined in the project*	Sustainability in ICT services
Duration *Specify the project's hours*	Three hours (90 min + 90 min)
Dates of implementation	Weeks 44 & 45
Learner target group *Specify the learner group that the project is designed for*	• Third year Business Information Technology students spesialised in Digital Business, Software Development and Game Development (35 persons in two groups) at Karelia University of Applied Sciences • Students study the complete degree online
Teacher(s) *Write here the names of teachers responsible for the project*	
Learner Engagement *Describe the ways you engage learners in the planning, implementation and*	• Discussing the objectives, outcomes and assessment criteria with students • Encouraging questions and problem solving in challenging situations • Self and peer assessment

assessment of the project	
External stakeholders *List the stakeholders involved and their role, e.g. guardians/parents, guest speakers, organisations, companies*	• Consulting an expert in green coding • Students consult alums (former students) working in ICT companies
Learning environments *Describe the spaces/locations where the learning happens*	Online implementation on the following platforms: • Moodle/Zoom for instructions and assignments • Collaborative learning platform Howspace for group work
Learning tools *List and describe the tools needed for the project e.g. digital devices/programs*	Outside group sessions, teams can decide their own communication channels that they prefer, e.g., Discord

SUBJECTS, GOALS, OBJECTIVES AND ASSESSMENT METHODS		
List the included subjects and the selected curriculum-based learning goals and objectives here. Define the assessment methods for each goal.		
Subjects	**Goals and Objectives**	**Assessment Methods**
Professional English	professional communication and interaction, teamwork	self and peer assessment, feedback from teacher/expert

Sustainable ICT	key challenges and solutions of sustainable development in ICT industry	self and peer assessment, feedback from teacher/expert

21ST-CENTURY SKILLS: GOALS, OBJECTIVES AND ASSESSMENT		
List the included curriculum-based 21st-century skills and their respective learning goals and objectives here. Define the assessment methods for each goal.		
21st-century/ Transversal Skill	**Specific Learning Goals and Objectives**	**Assessment Methods**
Learning to learn	research: finding relevant information	self assessment, guidance and feedback from teacher
Teamwork	discussing, analysing and evaluating information	self and peer assessment, guidance and feedback from teacher
Communication	presenting the results/outcomes	assessment discussion on the basis of assessment criteria

PROJECT PHASES AND SCHEDULE

Plan the pedagogical implementation for your project. For planning the phases for your project, you can utilise inquiry-based learning (see the handbook pp. 20-22) as a basis. These phases are provided in this form in brackets, but you can also apply any other pedagogic model suitable for phenomenon-based learning here.

Phase	**Date and Time (and teacher)**	**Description of Activities and Learning tasks**
Phase 1 (Orientation)	Preassignment before the group sessions	Students familiarise themselves with the topic through teacher-provided learning materials
	1st session in week 44	Discussing the learning objectives and assessment criteria

	1st session in week 44	Initial knowledge of the phenomenon, poll
Phase 2 (Conceptualisation)	1st session in week 44	Common understanding and interest of the phenomenon, post-it notes
	1st session in week 44	The phenomenon: organising the post-it notes into categories
	1st session in week 44	Forming groups based on specialisations
Phase 3 (Investigation)	1st session in week 44	Background materials provided by the teacher: videos, articles
	1st session in week 44	Teams choose their topics and research questions and allocate tasks and roles
	1st and 2nd session in weeks 44-45	Teams research their chosen topics
	1st session in week 44	Teams discuss their findings and document the main points
	1st session in week 44	Teams present the initial findings to the teacher(s) and get feedback
	1st session in week 44 / For homework between sessions	A poll about teams' collaboration and progress
	For homework between sessions	Students deepen their knowledge on initial results based on teacher-provided and self-acquired materials
Phase 4 (Conclusion)	2nd session in week 45	Teams give their final presentation and get feedback from teacher
	2nd session in week 45	Students reflect on their learning outcomes individually and do peer assessment

UNIVERSAL DESIGN FOR LEARNING
Special needs and barriers to learning in the group *Based on the knowledge of your learners, list the learning difficulties/special needs or other learning barriers in the target group that need to be addressed.*

- Social and performance anxiety
- Learning difficulties (challenges in concentration, staying focused and language processing)

Design the UDL-based support and accessible learning materials for your learners

Based on the knowledge of your learners, design the PhBL project to include multiple means for engagement, representation and action and expression. You can select, for example, 1 or 2 design options for each category.

For reference, this handbook offers ideas for UDL (pp. 55-58). Further resources on UDL are available in many different languages e.g. on this website: *https://udlguidelines.cast.org/more/downloads/*

Engagement	Representation	Action and Expression
Collaborative Goal Setting: • Involve students in discussing learning objectives and assessment criteria to foster agency, engagement and reducing anxiety. • Let students to decide their research topics and objectives collaboratively with others in teams	**Accessible Learning Content:** • Use both text and audiovisual resources, with captions and transcripts for videos. • Offer possibility to use AI tools for clarifying concepts, organising information and modifying learning contents into more accessible formats • External experts may be consulted to explain concepts	**Flexible Assessment:** Let students choose how to present their work visually
Choice and Autonomy: Allow students to choose their teams, topics, roles, and communication channels that support their motivation and comfort.	**Visual Supports:** Provide infographics, mind maps, and chunked content to clarify complex ideas and vocabulary.	**Role Choice:** Allow learners to select team roles that suit their strengths and comfort level.
Varied Participation: Offer options for anonymous polls, written or verbal contributionsflexible group sizes to reduce social anxiety.	**Language Support:** Offer glossaries, simplified summaries, and translation tools for key terms and concepts.	**Practice Opportunities:** Give formative feedback prior to the final presentation to help students improve their

		work and ease performance anxiety
Regular Feedback and Check-ins: Use (Howspace) polls and mood meters for ongoing feedback, helping students self-regulate and stay engaged.	**Read-Aloud & Text-to-Speech Tools:** • Provide digital tools that read materials aloud for students who benefit from auditory input • Encourage the use of digital reading practice tools, such as Microsoft Reading Coach, to practice reading presentations aloud	**Assistive Technology:** Encourage use of mind mapping software, speech-to-text tools, presentation practicing tools and grammar checkers
Authentic Context: Connect learning to meaningful real-world experiences (job interview) that make learning motivating and meaningful by tapping into personal goals and identities		

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Annex I - Template for planning a Phenomenon-based project

GENERAL INFORMATION	
Project's name	
Phenomenon *Define the phenomenon(a) that is examined in the project*	
Duration *Specify the project's hours*	
Dates of implementation	
Learner target group *Specify the learner group that the project is designed for*	
Teacher(s) *Write here the names of teachers responsible for the project*	
Learner Engagement *Describe the ways you*	

engage learners in the planning, implementation and assessment of the project	
External stakeholders *List the stakeholders involved and their role, e.g. guardians/parents, guest speakers, organisations, companies*	
Learning environments *Describe the spaces/locations where the learning happens*	
Learning tools *List and describe the tools needed for the project e.g. digital devices/programs*	

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SUBJECTS, GOALS, OBJECTIVES AND ASSESSMENT METHODS		
List the included subjects and the selected curriculum-based learning goals and objectives here. Define the assessment methods for each goal.		
Subjects	**Goals and Objectives**	**Assessment Methods**

21ST-CENTURY SKILLS: GOALS, OBJECTIVES AND ASSESSMENT		
List the included curriculum-based 21st-century skills and their respective learning goals and objectives here. Define the assessment methods for each goal.		
21st-century/ Transversal Skill	**Specific Learning Goals and Objectives**	**Assessment Methods**

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PROJECT PHASES AND SCHEDULE

Plan the pedagogical implementation for your project. For planning the phases for your project, you can utilise inquiry-based learning (see the handbook pp. 20-22) as a basis. These phases are provided in this form in brackets, but you can also apply any other pedagogic model suitable for phenomenon-based learning here.

Phase	Date and time (and teacher)	Description of activities and learning tasks
Phase 1 (orientation)		
Phase 2 (conceptualisation)		
Phase 3 (investigation)		
Phase 4 (conclusion)		

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UNIVERSAL DESIGN FOR LEARNING

Special needs and barriers to learning in the group

Based on the knowledge of your learners, list the learning difficulties/special needs or other learning barriers in the target group that need to be addressed.

Design the UDL-based support and accessible learning materials for your learners

Based on the knowledge of your learners, design the PhBL project to include multiple means for engagement, representation and action and expression. You can select, for example, 1 or 2 design options for each category.

For reference, this handbook offers ideas for UDL (pp. 55-58). Further resources on UDL are available in many different languages e.g. on this website: https://udlguidelines.cast.org/more/downloads/

Engagement	Representation	Action and Expression

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