

# DEVELOPMENT OF HIGHER-ORDER THINKING SKILLS WITH REDMENTA

A WHITE PAPER



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# 21st-century skills in education

**In the 21st century, soft skills are becoming more important, especially in the 4C areas: communication, collaboration, critical thinking, and creativity [1]. Challenges and changes of the 21st century draw attention to the need for higher-order thinking skills, which have become essential. In recent years, there has been increasing recognition of the need for higher-order thinking skills to succeed in an increasingly competitive and rapidly changing labor market. Higher-order thinking skills refer to cognitive processes that involve critical thinking, problem-solving, analysis, and creativity. These skills are typically considered to be more advanced than lower-order thinking skills, which involve basic understanding, recall, and application of information.**

Based on the DigComp 2.2 framework, concerning the emergence of AI (Artificial Intelligence), students need higher-order thinking skills to interact effectively and safely with these technologies. AI is a product of human intelligence; students need their problem-solving and critical thinking skills to identify AI systems, learn about them, and use them only in situations when it is justified. Their creativity is required when students co-design and co-create new products

and services with the support of AI systems. AI can play a quality-enhancing role in human written communication, but it also carries the risk of dehumanizing interactions [2]. As AI, robotics, and automatization develop and replace jobs that require traditional skills, and low education levels the demand for most physical and manual skills will decline [3]. On the other hand, technological development also creates new jobs; from 1999 to 2016, more than 23 million can be attributed

to this only in Europe <sup>[4]</sup>. There is already a growing need for workers in AI-related fields, data scientists, machine learning engineers, and technology will transform most of the job market <sup>[5]</sup>. However, these jobs require new skills, and there will be high demand for workers who master higher-order thinking skills, which is essential for success in a future economy increasingly driven by technology and automation.

### **Our paper focuses on four skills:**

- 1) creativity,**
- 2) analytic thinking,**
- 3) problem-solving,**
- 4) communication**

These skills are crucial for learning, working, and navigating the 21st-century world, as technology and automation will continue to shape the job market. By mastering them, students can prepare themselves for a rapidly changing workforce and be well-positioned for success in the future. Creativity is strongly needed to be able to solve everyday problems and indirectly achieve and maintain emotional and social well-being and success in life <sup>[6]</sup>. Analytic thinking is vital in society and involves breaking down complex problems or information into manageable parts in order to understand and solve them <sup>[7],[8],[9]</sup>. It is a systematic and logical method that utilizes critical thinking and problem-solving skills to analyze information and make decisions. Analytic thinking is closely tied to problem-solving and critical thinking and is used in school, the workplace, and daily life. Problem-solving is a behavioral process that generates a range of potential solutions to address a problematic situation and increases the likelihood of selecting the most effective response <sup>[10]</sup>. Effective communication is necessary to exchange information and analyze or solve problems and present creative ideas. Without communication skills, we cannot effectively articulate, receive, comprehend, and express feedback regarding facts, thoughts, opinions, feelings, and attitudes.

Digital technology provides various solutions to assist teachers to develop these skills in the classroom and beyond. Technology-based tasks can engage students in new and interactive ways, encouraging them to think critically and apply their knowledge in different situations. These tools can give students real-time and personalized feedback, helping them identify areas of strength and weakness and focus their efforts on areas that require improvement. Moreover, it can provide teachers with valuable data on student progress, allowing them to make informed decisions about their instruction, planning and supporting the learning process more effectively.

The educational platform Redmenta fulfills these aspects, allowing teachers to create tasks to assess and foster higher-order thinking skills, providing valuable insights into student understanding and progress. The platform's interactive features can engage students and encourage them to think critically, analyze information, and apply their knowledge in new ways. It also provides teachers with immediate feedback enabling them to adjust their instruction and support students more effectively. Redmenta is a Hungarian educational platform aiming to measure and enhance knowledge through worksheets, which provide a

wide range of task types for assessment or practice. Educators can utilize the platform for various purposes, such as homework assignments, tests, or exams. The platform is accessible to all individuals who would like to create tasks or worksheets.

This paper aims to present various methods and task types in Redmenta that can be used to develop creativity, analytic thinking, problem-solving, and communication. Since these four areas are strongly interlinked, as will be illustrated by the examples in the chapters, many of the tasks in Redmenta can be used to develop all four areas.





# 02

# CREATIVITY

## What is creativity?

- *The definition of creativity*
- *The creative process*

## Nurturing creativity in the school environment

## Nurturing creativity with Redmenta

- *Essay*
- *Flow chart*
- *Video Recording*
- *Creative board*

*“For individuals, creativity plays a crucial role in solving everyday problems as it is a vital aspect of problem-solving thinking and contributes to their emotional and social well-being and success.”*

*—Plucker*

# What is creativity?

## THE DEFINITION OF CREATIVITY

For individuals, creativity plays a crucial role in solving everyday problems as it is a vital aspect of problem-solving thinking and contributes to their emotional and social well-being and success <sup>[6]</sup>.

Many organizations and businesses seek employees who are capable of using their creative skills to resolve professional issues, improve the organization and maintain its competitiveness. In a society, creativity is an indispensable component of social and technological progress, improvement of living standards, and cultural advancement <sup>[6],[11]</sup>.

The word creativity is used in many ways in our everyday lives. However, according to the scientific definition, an idea must meet several criteria in order to be called creative. Nowadays, there is no consensus among researchers regarding the definition of creativity. Based on Csíkszentmihályi's definition a creative idea changes or transforms an existing domain (in other word: discipline). Therefore, the creative person is someone who

changes a domain or establishes a new one <sup>[12]</sup>.

Based on these definitions, the number of ideas and persons that can be labeled as creative is significantly reduced since only those discoveries and breakthroughs can be called creative that made a lasting impact on the development of humanity and our culture or on another area. As this may seem unattainable for an ordinary person, we define different types and levels of creativity.

According to another approach, creativity means the creation of new, original, but at the same time, useful products <sup>[13]</sup>. It is therefore important to emphasize that an unusual, novel idea is not enough for creativity, it must also have some useful, problem-solving function. Bereczki and Kárpáti <sup>[14]</sup>, also state that students' ideas can be titled creative based on their originality and value in the classroom context. The group of individually creative, innovative, original thinking people is identified by creativity written with a small c, while the group of scientists and artists who significantly changed our culture is characterized

by Creativity, which should be written with a capital C <sup>[12]</sup>. More recent literature separates additional levels within these two (Figure 2.1): Big-C, or eminent creativity, is the highest level; only a few people can reach this level of creativity (for example, Albert Einstein, Mozart, etc.); this is the level that Csíkszentmihályi is referring to in his work. Big-C is followed by Pro-C, which refers to the professional level, achievements of scientists, artists, etc. Then comes little-c, which stands for everyday creativity, for example writing a poem, solving a simple problem, and finally mini-c, which is the internal, subjective creativity, that is useful for the individual during the acquisition of experience and knowledge, for example children's play <sup>[15]</sup>. Of these levels, the development of small-c and mini-c is naturally emphasized in school contexts as they could be the basis of Big-C and Pro-C <sup>[15]</sup>, and it can also be developed by the teachers <sup>[14]</sup>.

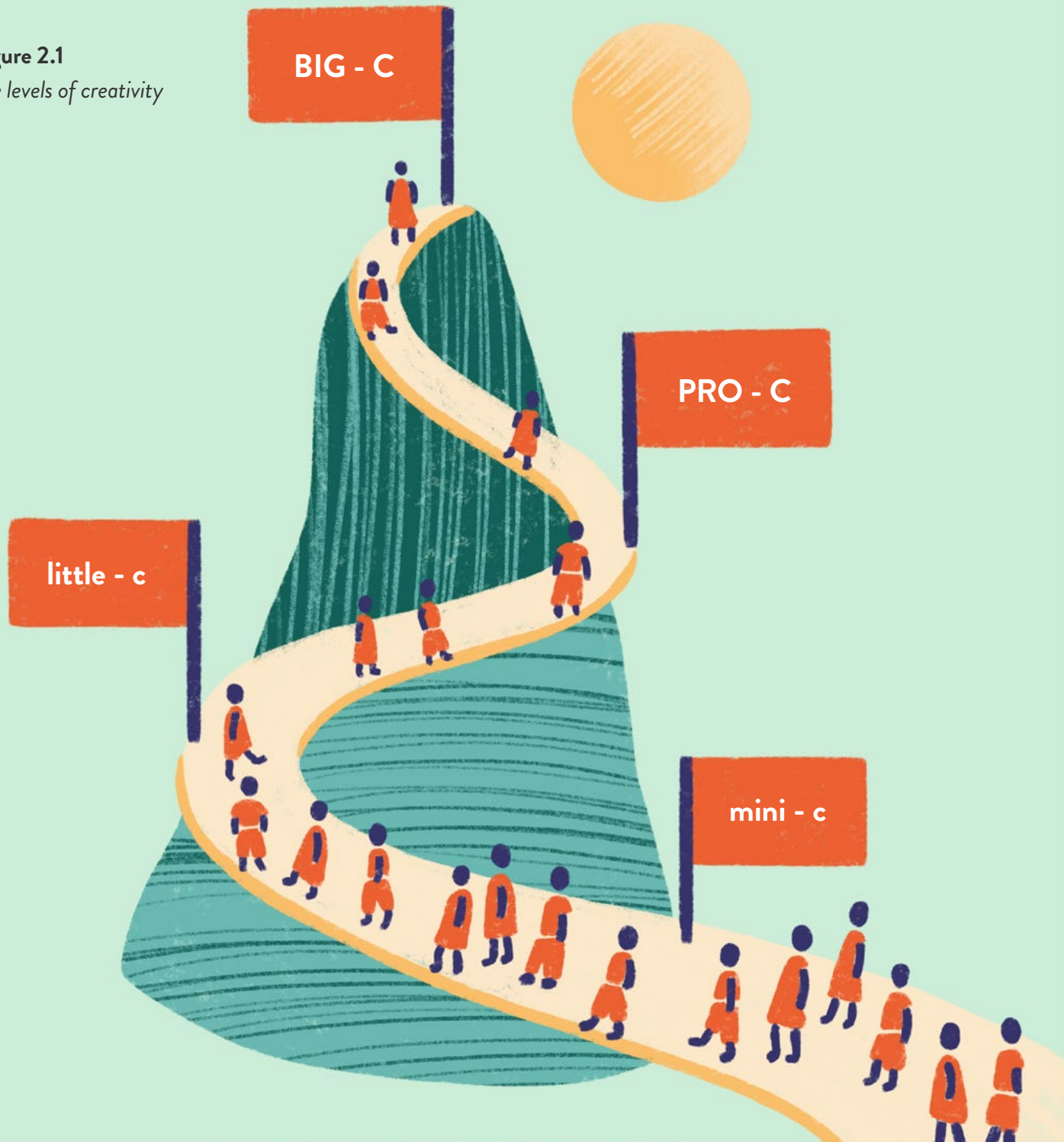
## THE CREATIVE PROCESS

**The birth of a creative idea is a long process <sup>[12]</sup>, during which a person has to pass through many stages to generate a sufficiently developed, novel idea often a part of the eureka and the flow experience.**

In the study by Lubart et al. <sup>[11]</sup>, the process of creativity means alternating two types of thoughts and actions: extensive or expansive divergent-exploratory actions, and intensive, focusing convergent-integrative actions.

Divergent thinking is a concept that was introduced by Guilford <sup>[16]</sup>, as part of his Structure of Intellect model, in which he characterized it as a problem-solving approach. Divergent thinking involves generating numerous solutions or ideas for a given topic or issue, and it differs from convergent thinking tasks, such as traditional intelligence tests, which involve identifying one or a few correct answers. Exploring divergent thinking is a significant method used to understand the cognitive processes that underlie creative performance.

**Figure 2.1**  
*The levels of creativity*



In the realm of education, it has been recognized as an indicator of creative potential <sup>[17],[18]</sup>.

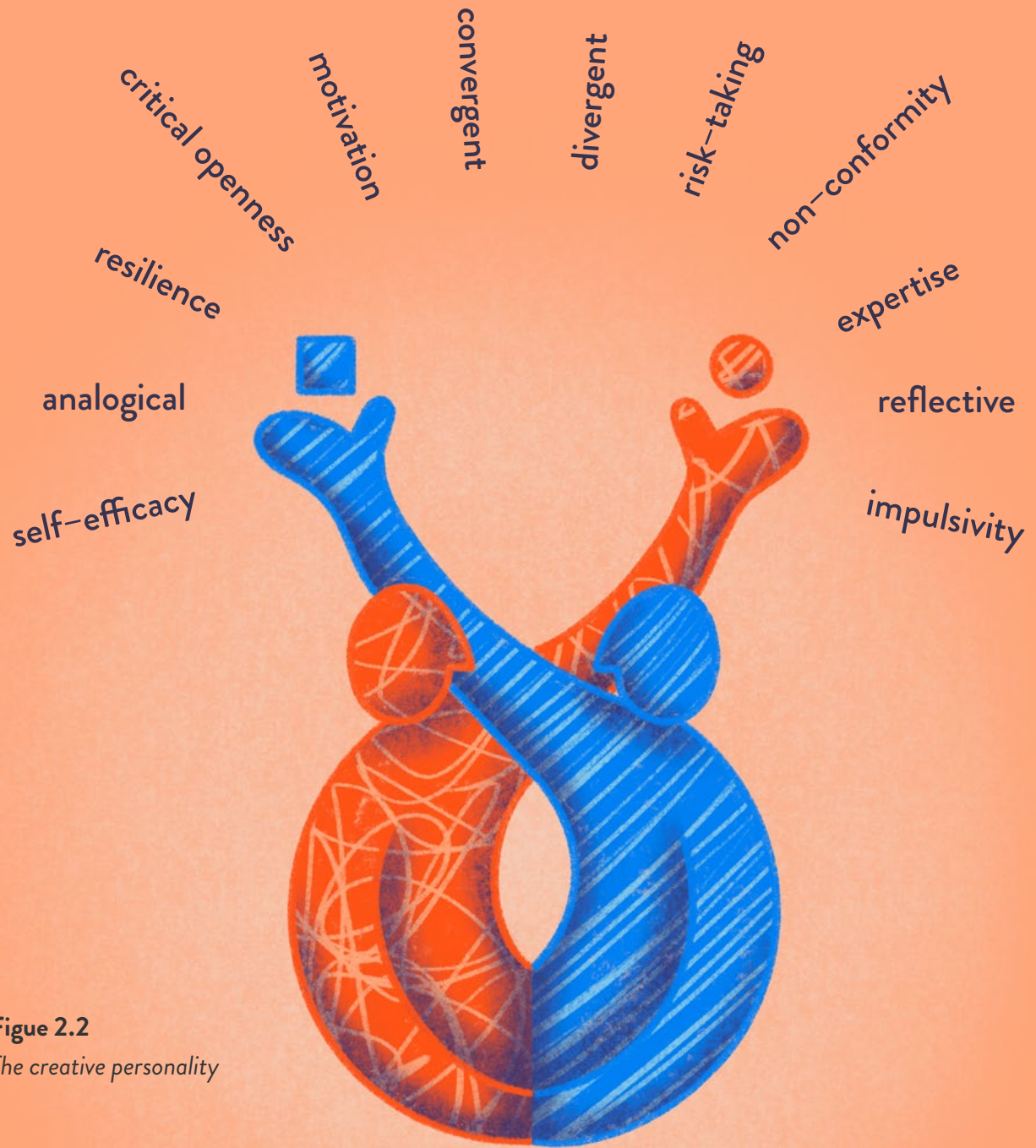
The 4P model highlights four main components of the creative process. These are the creative persons, the process of creation, the created product, and the environment (press/place) <sup>[19]</sup>.

As it can be seen in Figure 2.2. , in their work, Bereczki & Kárpáti <sup>[20]</sup>, refer to research in which the most essential characteristics of creative personalities are openness to experience, creative self-efficacy, task motivation, domain knowledge, and expertise, risk-taking, and resilience in the face of criticism and also non-conformity, impulsivity and disruptive behavior in addition to some cognitive abilities, such as divergent, critical, analogical and reflective thinking <sup>[20]</sup>. Mihály Csíkszentmihályi <sup>[12]</sup>, also highlights the problem that the personality traits necessary for creating new ideas often contradict those necessary for disseminating new ideas, making it difficult to obtain recognition for a creative idea that has already been born.

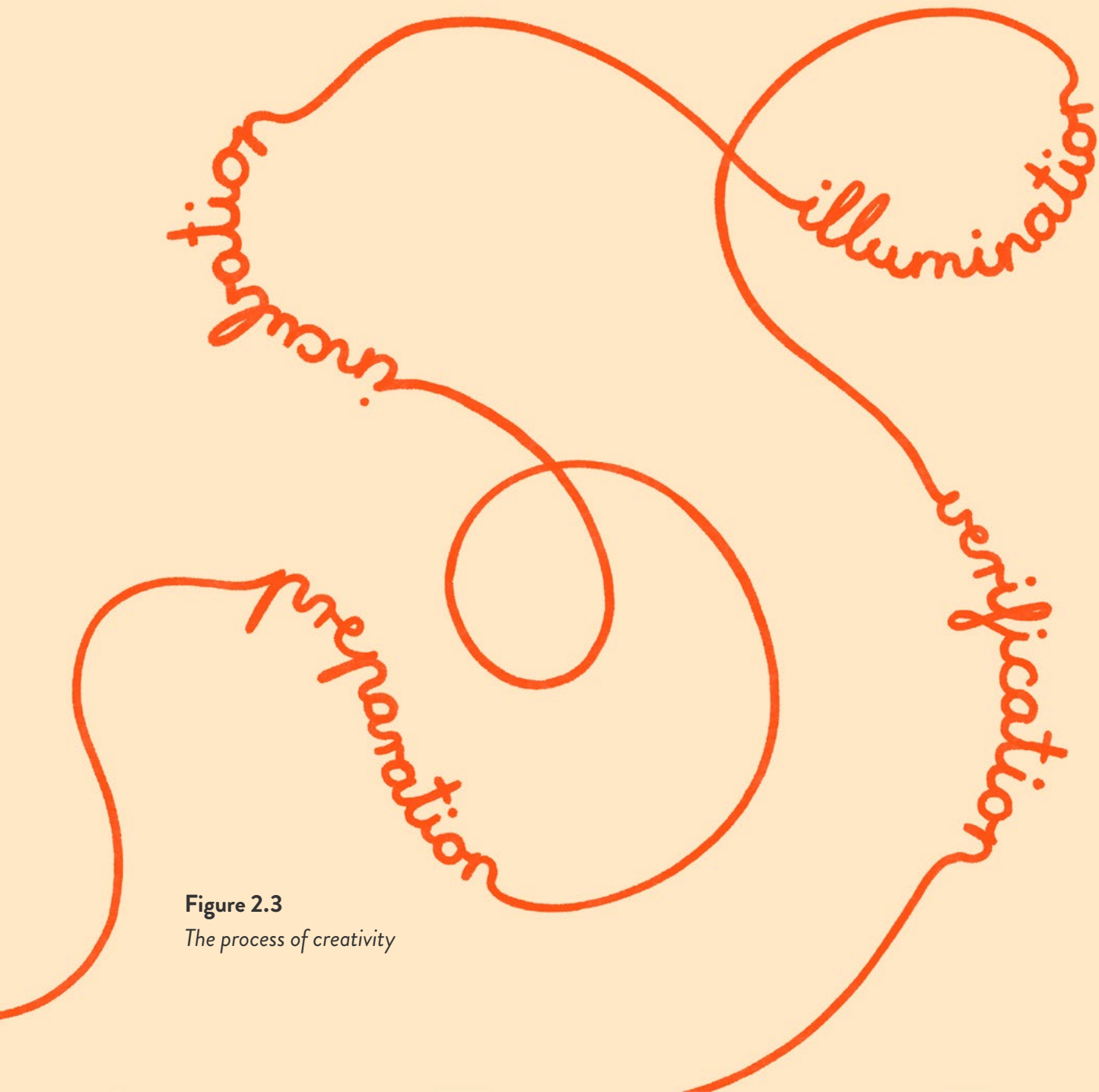
The creation process is also divided into several steps, all of which are necessary to create an innovative, creative idea. First comes the

preparation level, when we cumulate knowledge. After that, the long stage of incubation, when we don't think about the problem consciously, followed by the illumination stage, which is the so-called "aha" experience, when the idea suddenly flashes into mind, and then last, but not least the verification stage <sup>[21]</sup>, (see Figure 2.3).

Creativity can also be helped by the environment, as well as various positive reinforcements and influences within it, for example, „the physical (flexible use of space, flexibility and free movement, availability of diverse tools, materials, and technology), the pedagogical (original and exciting learning activities, authentic and realistic tasks, playful approaches, ensuring time for ideas, allowing students ownership of their learning), the psychosocial (trust, mutual respect, collaboration), and the external (collaboration with outside agencies)” <sup>[14]</sup>, factors.



**Figure 2.2**  
*The creative personality*



**Figure 2.3**

*The process of creativity*



# Nurturing creativity in the school environment

**Besides the not-so-common Big-C and Pro-C, the little-c and mini-c levels of creativity are present in school classes. Thus, the development of these skills can also be realized in a school environment [22].**

Effective development can be aimed at several areas, especially if the training is „systematic, targets domain-specific cognitive skills, includes opportunities to develop creative attitudes and behaviors, and involves realistic tasks and practice, as well as collaboration with peers” [20]. Creative thinking appears prominently within the learning process during evaluation, divergent creation, redefinition, and experimentation [23]. It is also essential to strengthen constructive thinking, encourage further reflection, and provide warm-up tasks without illustrations or examples [22]. Let’s encourage students to use

their creativity by responding positively to their unusual questions and solutions, motivating them to practice self-initiated learning, and avoiding immediate evaluation [23]. The development of creativity can also be achieved with the help of digital tools [24]. Moreover, they can support the creative process with their many favorable properties; for example Redmenta can serve these pedagogical aims if used consciously.

# Nurturing creativity with Redmenta

In the case of the Redmenta interface, teachers can work with several types of tasks that can contribute to developing children's creativity, if used properly. The interface makes it possible to score the tasks manually, however, during the evaluation of creative tasks, only extra points should be earned and originality as an evaluation aspect should be emphasized <sup>[22]</sup>, and we should also encourage students to think of several different solutions <sup>[11]</sup>. For the evaluation of creativity and divergent thinking, several aspects are taken into account by measurement tools. The most frequently encountered factors based on Torrance <sup>[22]</sup>, are:

- **fluency (how many different evaluable solutions were created);**
- **originality (how unusual and original the solution is compared to other's solutions);**

- **flexibility (to what extent the answers differ from each other, change of perspective)**

Redmenta can also be used to guide the whole creative process. As a complex example, the teacher can ask students to design a logo for an imagined organization about the current topic of their learning process for example: designing a logo for an ancient school, or for a ceramic community that only uses circles and spheres in their work, or for a campaign that stands for environmental protection, or the Dead Poets Society (See Figure 2.4). Since Redmenta saves the worksheets automatically, students can work on this project for multiple days without losing their progress; they can reopen the worksheet at any time, the teacher just has to make sure that there is no time limit by checking the settings. On Monday, students get the assignment. For their homework, they will

have to gather information, make notes about the topic (Short answer), and draw their first sketch of the logo (Creative board). On Tuesday, their second task is to write down a few sentences about the logo (Essay). Guiding questions can be for example: what symbols appear on the logo? What needs to be changed about the logo? The same day they also have to draw another sketch. They can copy the first one as it was or add new elements (Creative board). After that, on Wednesday, they have to finalize the logo (Creative board) and make a 60-second long video introducing it (Video recording). They can always re-record the video if they are not satisfied with the results. Finally, on Thursday, they have to create a shortened version, a 30-second long video of the introduction (Video recording) that will be presented for the class on Friday. Then the teacher can access and evaluate the whole process in one worksheet after the students hit the submit button.

**Figure 2.4**

*Example for the stages of creating a logo project*





# Creating a logo project

Create a logo for an imaginary ancient school.

1 SHORT ANSWER ?

**Day 1: Gather information and make notes about ancient schools.**

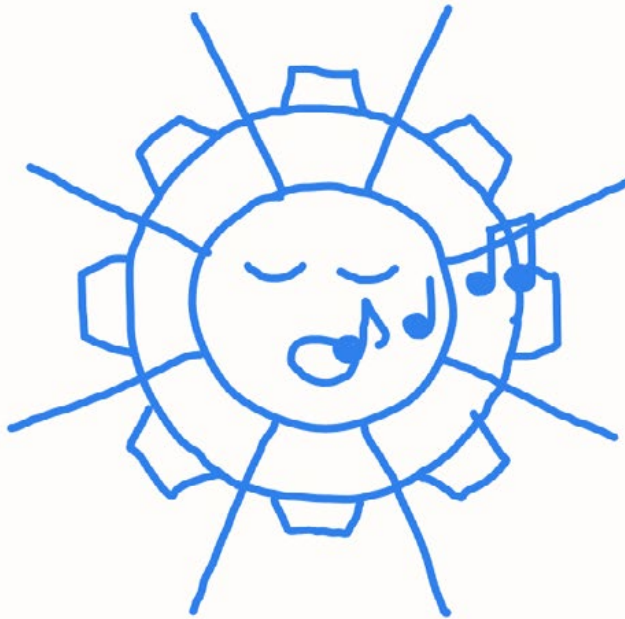
- China
- Zhou dynasty (1045-256 BC)
- Educate aristocrats, government school
- About rituals, literature, politics, music, arts and archery
- Six Arts: rites, music, archery, charioteering, calligraphy

Source: [https://en.wikipedia.org/wiki/History\\_of\\_education](https://en.wikipedia.org/wiki/History_of_education)

\* Add source



Day 1: Draw the first sketch of your logo.




Cancel

Save

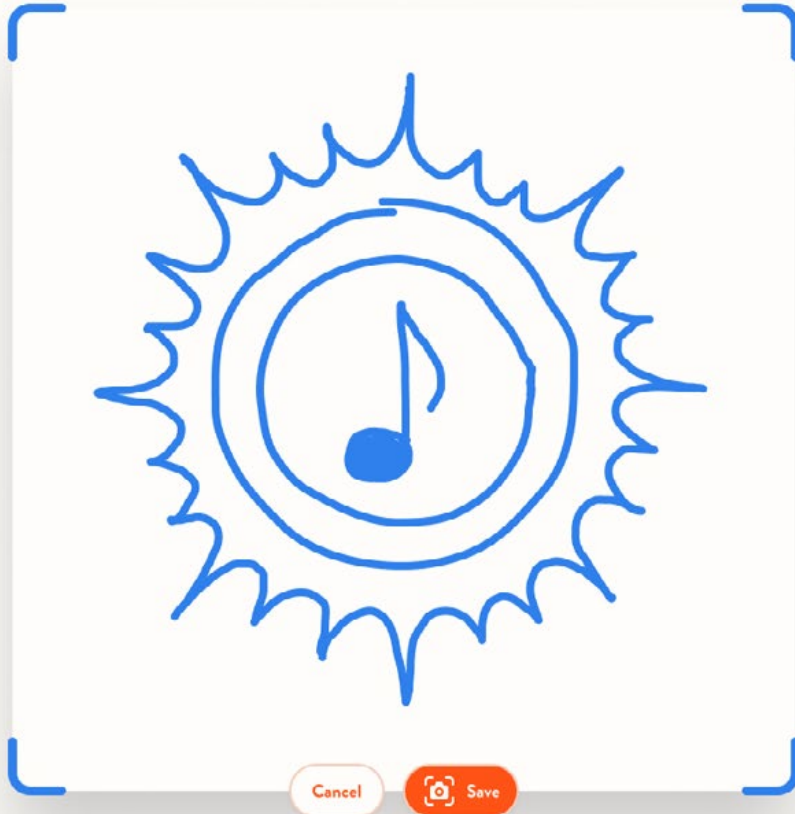


**Day 2: Write down a few sentences about the logo. Think about what symbols appear on the logo. What needs to be changed about the logo?**

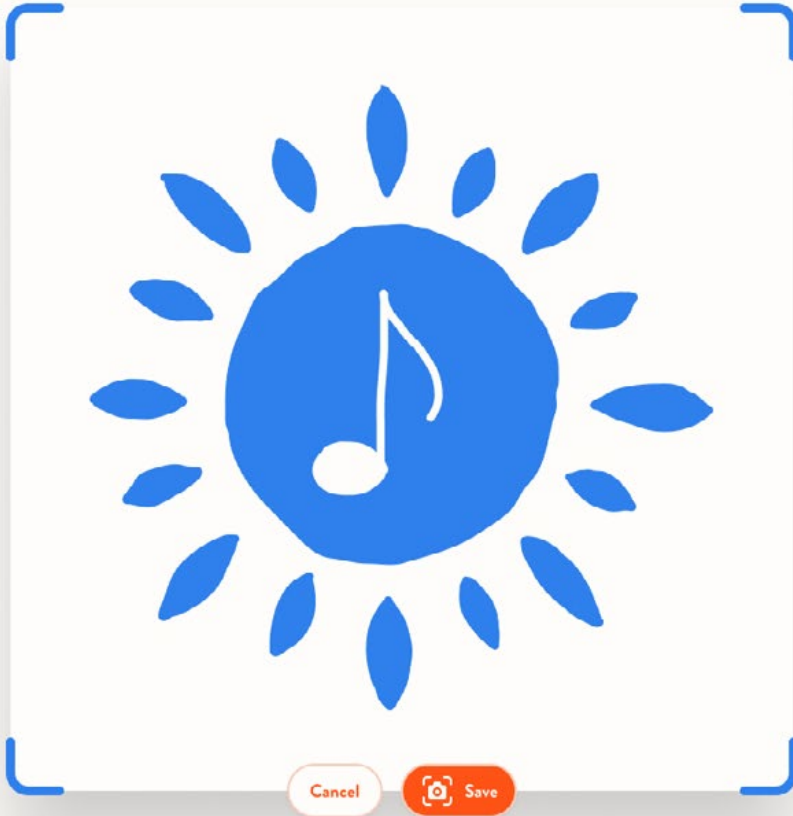
 It depicts a sun that sings. The sun had a central role in ancient cultures, it is also linked to music, because music and art were important in expressing religion so they appear in school. The logo also shows symmetry and the central role of the sun.



**Day 2: Draw another sketch of your logo. You can either copy the first one as it was or add new elements to it.**



Day 3: Finalize your logo.





Day 3: Make a 60-seconds long video introducing the logo.





## ESSAY

In the case of essays, encouraging creative writing can be a practical exercise. When formulating the task, contradictions, and uncertainties can be raised, provocative questions can be asked to encourage the examination from a different point of view, and we can provide little information from which the students have to draw conclusions and create hypotheses. We can have them examine riddles and puzzles and offer them a possible solution to a problem, which they should try to solve better/differently. We can encourage them to approach the given task from several points of view, and we can ask them to take notes of observations involving several senses – which develops the ability to perceive the environment – or take notes of trying out and testing their ideas [22]. This can also contribute to the development of their critical thinking.

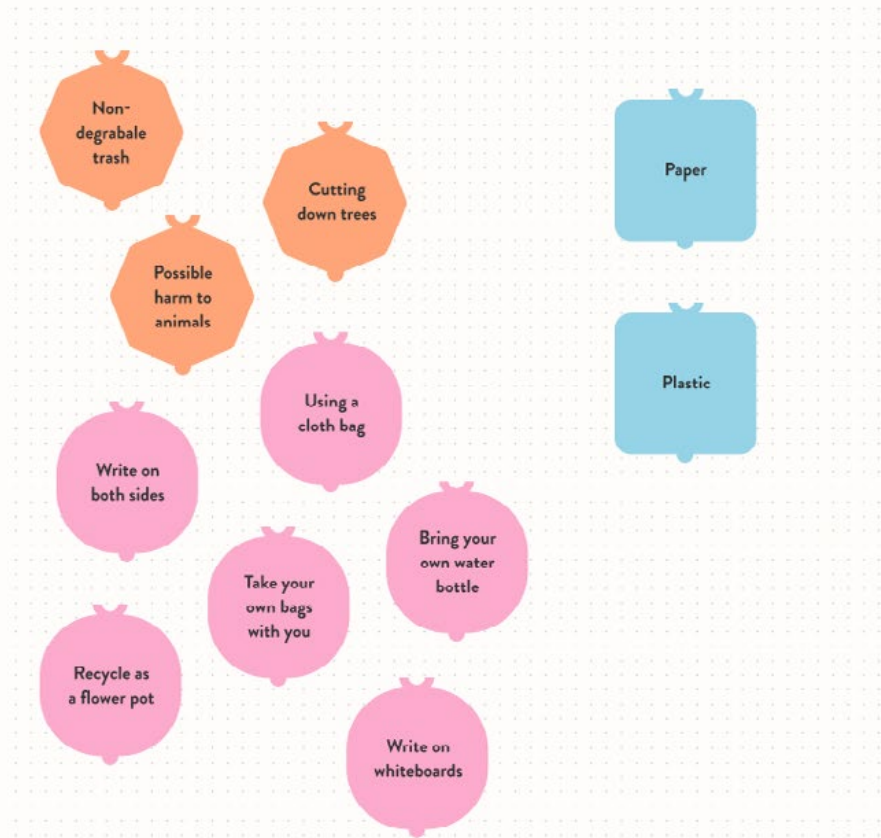
## FLOW CHART

When creating the flow chart, we make sure to include irrelevant information, which the students have to filter out. We can also provide them an incomplete diagram after solving the task which encourages them to explore missing information and think of possibilities. They can collect and note these in an Essay task. Without scoring the right answers, we can also use the task to give students the opportunity to reorganize previous information [22].

### **Figure 2.5**

*An Example for a Creative Task Using the Flow Chart* ►

Create a flowdiagram using the ideas listed below! Move “paper” and “plastic” to the center and move the possible harm of their overusage onto the top of the page and move the possible solutions of their overusage under them. Connect them to either “paper” or “pastic” based on your logic.



## VIDEO RECORDING

In the digital space, many programs and applications can help develop creativity, such as image, video, audio resources, and programs enabling the creation of digital content <sup>[14]</sup>. For this type of task, it is worthwhile to strive for visuality, even to add drama pedagogy elements to the task <sup>[22]</sup> for example act out a short speech as if they were a chosen character (Hamlet, or a medieval leader, or the poet who wrote the poem that they have to analyze, etc.). Figure 2.6 can also serve for inspiration.

### **Figure 2.6**

*An Example for a Creative Task  
Using the Video Recording* ▶



## CREATIVE BOARD

Divergent thinking can also be encouraged with digital technologies <sup>[14]</sup>, an example can be seen in Figure 2.7 such as electronic brainstorming, and in the case of the creative board, graphic representation, and visualization of events and locations can also have a positive effect on the development of creativity <sup>[22]</sup>.

### **Figure 2.7**

*An Example for a Creative Task  
using the Creative Board* ▶

Reuse something! Find an object in your home that you don't use anymore and create something new out of it! Think of at least 3 ways to make that object useful again! Upload a picture of your ideas and create an informative poster about your solutions! You can get bonus points if you create something that the other students didn't think of!

sandwich  
maker made  
of iron



Cancel

Save





# 03

# ANALYTIC THINKING

What is analytic thinking and why is it important?

The development of analytic thinking

- *The power of arguments and questions*
- *Visualization of information with mapping tools*
- *Practice every day*

Using Redmenta to foster analytic thinking

- *True or false*
- *Matching*
- *Flow charts and creative boards*
- *Essays*
- *Create their own worksheets*

*“Analytic reasoning is a type of reasoning that involves breaking down complex problems or information into smaller, more manageable parts in order to understand and solve them.”*

*—Sternberg*

# What is analytic thinking, and why is it important?

Analytic thinking is one of everyday life's most commonly used reasoning skills. Reasoning is the process of thinking about something in a logical way to form a conclusion or judgment <sup>[25],[26]</sup>. It involves using evidence, facts, and information to make inferences, evaluate arguments, and solve problems. Reasoning can be deductive, in which a conclusion is drawn from premises believed to be true, or inductive, in which a conclusion is drawn from a pattern of evidence or specific examples <sup>[27]</sup>.

**It is an essential cognitive function for students that allows them to make sense of the world around them, make informed decisions, and solve problems.**

Analytic reasoning is a type of reasoning that involves breaking down complex problems or information into smaller, more manageable

parts to understand and solve them <sup>[7],[8]</sup>. It is a systematic and logical approach that uses critical thinking and problem-solving skills to analyze information and make decisions <sup>[28]</sup>.

Analytic thinking is part of every student's learning process and an essential element of reading comprehension. Students are able to understand new information and concepts by breaking them down into smaller, more manageable parts. They also make connections between different pieces of information and understand how they fit together <sup>[29],[30]</sup>.

Analytic thinking is vital in our life because it allows individuals to break down complex problems and find solutions. It helps people identify the root cause of a problem and develop a plan of action to address it. It helps evaluate information and options, and weigh pros and cons, which leads to making informed decisions. Without analytic

thinking planned and informed decision-making would not be possible. Simply, it allows people to make well-reasoned and well-informed choices <sup>[28]</sup>.

This thinking skill is invaluable in a world where we have to live in a constant stream of information through the Internet, and we are constantly bombarded with unnecessary and often misleading information. Therefore, when we discuss analytic reasoning, we also need to mention critical thinking. Analytic thinking helps individuals evaluate the credibility of sources, identify biases, and consider alternative perspectives. This approach allows people to think critically, make more informed judgments and avoid being misled <sup>[9]</sup>.

**In summary, analytic thinking is essential in everyday life because it helps individuals make sense of complex information, make informed decisions, and communicate effectively. It is a valuable skill that can help people navigate the complexities of modern life and make better choices in a personal and professional context <sup>[31]</sup>.**

# The development of analytic thinking

As was presented before, analytic thinking involves breaking down complex problems and finding solutions <sup>[9],[29]</sup>. But how can we develop analytic thinking within school settings? Development of this skill requires much practice on complex problems. Teachers can create tasks that require evaluating information and arguments, or it is possible to help students master methods that are possible to use in the future to analyze problems, e.g., using mind-maps or learning how to raise questions. And for the development of analytic thinking, educational technology offers interactive environments and many solutions that can be more engaging for students. Technology enables processing information from multiple sources and media types, including data and audio-visual communication, through activities such as searching and analyzing. These activities can only be accomplished with the assistance of technology.

## THE POWER OF ARGUMENTS AND QUESTIONS

According to Byrnes and Dunbar <sup>[29]</sup>, asking questions to clarify information and gain a deeper understanding requires the use of analytic thinking skills. A practical approach is raising questions to decide the reliability of information <sup>[30]</sup>, or evaluating evidence and arguments to determine their validity. One possible way to foster analytic thinking skills is to create a learning environment or task which includes well-constructed arguments and supports students' inquiry. Teachers can facilitate this by posing questions and providing opportunities for discussion, debate, and collaboration among students. Open-mindedness and willingness to revise beliefs based on new evidence or arguments are also important elements of the learning process and connected to analytic reasoning. Creating group or individual tasks and activities

using metacognition (thinking about one's own thinking and learning) to make decisions with analytic reasoning instead of intuition will also support the development of analytic thinking<sup>[32]</sup>.

## **VISUALIZATION OF INFORMATION WITH MAPPING TOOLS**

Another way to develop analytic thinking is to use mapping tools or graphic organizers, such as mind-maps or concept-maps, to break down problems or concepts into their elements and their connections. In mind mapping, concepts are linked in a network of connections and relationships. The connections between ideas in a mind map can be made freely, allowing for spontaneous and creative thinking<sup>[33]</sup>. The goal of mind mapping is to discover novel associations between concepts. Mind-maps are frequently used tools in education because they provide a better understanding of complex problems and concepts through visual representations of information and its connections. While mind mapping offers a certain freedom for students, concept mapping follows a structured approach, focused on outlining relationships between ideas, rather than generating spontaneous connections. Concept mapping has a hierarchical structure with multiple layers. It is

a relational tool rather than a pictorial one<sup>[33]</sup>. Concept mapping can foster critical thinking abilities, including analytic reasoning<sup>[34]</sup>. Graphic organizers display the relationships between information, with popular types being matrices, flowcharts, Venn diagrams, branching diagrams, and concept maps. Mind-maps are adaptable and encourage creative thought, generating new ideas and innovative solutions to problems<sup>[30],[35]</sup>.

## **PRACTICE EVERY DAY**

The role of metacognition in the development of analytic reasoning has received increasing attention. Teachers can encourage students to reflect on their learning process and their decisions while solving a problem<sup>[36]</sup>. It is also important to show real-world examples and the relevance and importance of analytic thinking in everyday life. Using real-world scenarios in the classroom can enhance students' motivation and engagement in the learning process. It can help students apply the concepts they have learned to practical situations and develop critical thinking skills<sup>[37]</sup>.





# Using Redmenta to foster analytic thinking

Educational technology and especially technology-based assessment, provide several opportunities to challenge and develop students' analytic reasoning skills. Technology can help students engage in complex and authentic tasks promoting deeper understanding and analysis, and with immediate feedback on their performance, teachers support them in adjusting their thinking strategies as needed. Redmenta offers various task types that can foster analytic thinking.

With Redmenta, teachers can design worksheets that incorporate both static and interactive elements. For example, on the subject of digital safety, a worksheet can be created that begins with presenting a scenario involving a potential digital safety risk, presented either as text or through an embedded video within the platform. Students are asked to analyze the scenario and identify potential dangers and risks. Using multiple-choice questions or flow chart question

types, students are prompted to evaluate and organize potential solutions and determine the best course of action. Finally, students are required to provide a comprehensive explanation for their chosen answers, which may include a presentation of their analysis and evaluation.

## TRUE OR FALSE

Using true or false questions is a simple way to include the development of analytic thinking skills in a worksheet. To achieve this, teachers need to develop a set of clear and concise statements that compel analyzing information, identifying patterns, and drawing conclusions, phrased in a way that can be answered with a true or false response and also align with the learning objectives (Figure 3.1). Ensuring neutrality and impartiality is essential, so we must avoid statements open to interpretation.

**Decide whether the following statements about online activities and their potential privacy risks are true or false!**

Deleting your browsing history and cookies will protect your online privacy.

True   False

It is safe to share personal information on social media as long as your account is set to private.

True   False

It is safe to use the same password for multiple online accounts as long as the accounts are not related.

True   False

**Figure 3.1**

*True or false questions about digital privacy risks*

## MATCHING

Solving matching questions can require analytic thinking skills. For example, we can present a list of concepts or statements on one side and a list of possible explanations, categories, or solutions on the other side. Then, as students match the correct statements with the right solutions or explanations, teachers can assess whether students can analyze information and categorize it based on relevant attributes and their ability to understand the relationships between concepts and apply their knowledge to solve problems (See Figure 3.2).

### **Figure 3.2**

*Example for a matching question following a video resource*



Check out the following video about cyber security and match the type of digital privacy threat with the corresponding protective measure!



Phishing



Avoiding clicking on unknown links

Malware



Keeping software up-to-date

Social engineering



Strong passwords and authentication

## FLOW CHARTS AND CREATIVE BOARDS

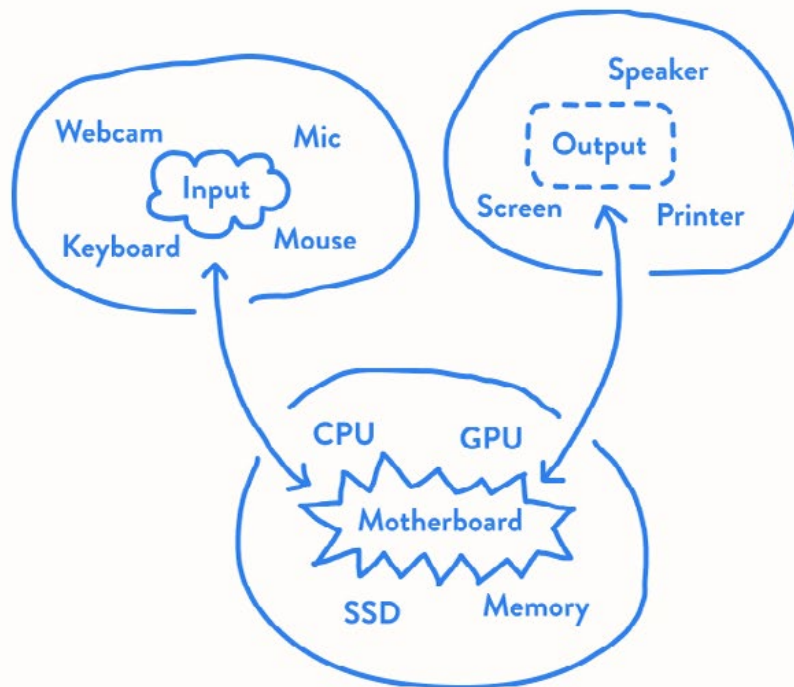
Research suggests that creating mind-maps or concept-maps can be great tools for developing analytic thinking <sup>[33],[34]</sup>. Redmenta offers two question types supporting these methods: flow charts and creative boards. In flow chart-type questions, teachers can include the elements and indicate different layers. Students can be asked to organize those elements and draw connections to create a concept-map. While creative boards offer ways to create tasks with mind-maps. Using graphic organizers in the form of creative boards gives students more freedom in their learning process. This approach accommodates mind mapping, but with appropriate guidance and specific instructions, it can also be adapted for concept mapping (See Figure 3.3).

### Figure 3.3

*Figure idea: Concept-map created by a student*



Create a concept map on the topic of computer hardware that illustrates the relationships and functions of different components. Identify the main hardware components, and establish connections between them, exploring their interactions and dependencies.



Cancel

Save

## ESSAYS

One way to get students to practice analytic reasoning is to assign essay tasks. However, to call for analytic thinking skills, we need to provide specific instructions which ask students to use evidence to support arguments, supply guidelines for evaluating information, and acknowledge other perspectives, as it is shown in Figure 3.4.

## CREATE THEIR OWN WORKSHEETS

Finally, analytic thinking also means that students can ask the right questions. Teachers can create a learning environment in the classroom where raising questions is supported, and by creating their own worksheets, they will learn to break down complex topics or problems into questions. Students can easily share their worksheet with their teacher or peers.

Sophie is a teenager who is very active on social media platforms. She loves posting photos and sharing her thoughts and opinions with her friends online. One day, she received a friend request from someone she didn't know. The profile picture looked friendly, so she accepted the request. Over the next few weeks, the new friend started sending her private messages, asking personal questions, and making comments about her appearance. At first, Sophie didn't mind, but then the messages became more frequent and aggressive. She felt uncomfortable and decided to block the person. However, a few days later, Sophie received a message from another stranger with a similar profile. This time, she knew that she needed to take action to protect herself.



Read the following story and answer the questions below. You should use your critical thinking skills to analyze the situation and provide well-reasoned answers based on your understanding of digital security.

- 1.) What are the potential risks of accepting friend requests from strangers on social media platforms?
- 2.) What steps could Sophie have taken to protect her privacy and safety when she received the first message?
- 3.) How can teenagers like Sophie be proactive in protecting their own online privacy and safety, and what advice would you give them to stay safe?

In your essay, be sure to provide well-reasoned answers to the questions above, supporting your points with examples and evidence where possible. Your essay should be approximately 300 words in length and demonstrate your ability to think critically about digital security issues.



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**Figure 3.4**

*Example for an essay task  
fostering analytic thinking*





# 04

# PROBLEM- SOLVING

What should we know about problem-solving?

How to nurture problem-solving skills?

How to nurture problem solving skills with Redmenta?

- *Multiple Choice and Short answer/Essay*
- *Sets*
- *Short answer/Essay*

***“Any goal–directed sequence  
of cognitive operations can be  
problem–solving.”***

***–Anderson***

# What should we know about problem-solving?

Problem-solving is a natural part of everyday life, yet it is hard to define. According to Anderson [38], any goal-directed sequence of cognitive operations can be problem-solving.

**“Problem-solving is a behavioral process, whether overt or cognitive in nature, which makes available a variety of potentially effective response alternatives or dealing with the problematic situation and increases the probability of selecting the most effective response from among these various alternatives” [10].**

Divergent thinking is an important factor in problem-solving since it is the ability to search for new ideas [39]. The ability to generate multiple answers to an open problem [40], makes it more

likely to come up with an original and novel idea [39]. An open-ended approach means a problem with more than one correct method or solution and multiple correct answers [41].

# How to nurture problem-solving skills?

Problem-based learning is an instructional approach [42], that is bedded in a problem-solving process.

**“In problem-based learning (PBL) students work with their peers to solve complex, authentic, real-world problems that help develop content knowledge as well as problem-solving, critical and creative thinking, reasoning, communication, leadership and self-assessment skills”**[43],[44],[45].

This is a student-centered approach that lets students conduct research, integrate theory and practice, apply knowledge and skills, and practice self-directed learning by working in groups and starting with an open-ended (also called „ill-structured“) problem. This type of problem has

multiple solutions with several solution paths to consider [42],[43]. This method requires metacognitive awareness from students, which has to be highlighted by the teacher [43], and students also „must learn to be conscious of what information they already know about the problem, what information they need to know to solve the problem, and the strategies to use to solve the problem” [43]. By making students observe the structure beneath the surface, PBL also helps to transfer the gained knowledge and skills to other situations [44].

**Figure 4.1**

*The steps of PBL* ►

END

7.

Group shares results of private study (students identify their learning resources and share their results), tutor checks learning and may assess the group

6.

Private studying (all students gather information related to each learning objective)

5.

Formulating learning objectives

4.

Reviewing steps 2 and 3 and arranging explanations into tentative solutions

2.

Defining the problem or problems to be discussed

1.

Identifying and clarifying unfamiliar terms

3.

Brainstorming, discussing the problem(s), suggesting possible explanations on basis of prior knowledge; identifying areas of incomplete knowledge

START



Teachers act as facilitators during PBL [44]. However, they also have a challenging task beforehand: formulating an ill-structured problem. An ill-structured problem is usually open-ended, complex and requires collaboration and higher-order thinking. It contains less information needed to understand the problem entirely, and therefore multiple solution paths are available, which causes

students to state questions about the problem. The “right” way of solving the problem is not apparent, and students don’t get feedback for their decisions during the problem-solving process [43]. After creating the ill-structured problem, the teacher introduces it to the class, and the problem-solving process begins (see Figure 4.1).

## How to nurture problem solving skills with Redmenta?

Based on the PBL method, the evaluation should focus on process-oriented objectives instead of content-oriented objectives [43]. For example, by using Redmenta as an online journal, students can write down the stages of the problem-solving process. We can create a worksheet containing Essay questions about the steps listed above, and students will use this tool as a checklist for the process. For example, the teacher can create an ill-structured problem about an area where industrial smog pollutes the air. Students must find ways to solve this problem. The teachers

can demonstrate the ill-structured problem in a more engaging way for the students by adding video content. They can set a deadline for the demonstration of their findings and students can work in groups using the Redmenta worksheet as a guidance. During the process, students can consult with their teacher in person, during class to get feedback and to get help for their progress and in the end, after the process is finished and the students submitted their work, the teacher can evaluate their progress by checking all stages of progression instead of evaluating only the final

result, the found solution. Encouraging students to solve problems in different or multiple ways also develop creative problem-solving skills<sup>[46]</sup>. Another great way to enhance divergent thinking is brainstorming<sup>[39]</sup>, and creative boards can serve this purpose if we ask the children to create a mind map about a specific problem/topic.

Peer ratings and self-assessment both supports self-directed learning<sup>[42]</sup>, but they have to be supplemented with the instructors' detailed comments, and feedback, moreover, mistakes should be allowed and viewed as learning opportunity<sup>[43]</sup>. Essay questions at the end of a worksheet can be used to ask the students about the performance of the group/their peers or about their own effort.



## **MULTIPLE CHOICE AND SHORT ANSWER/ESSAY**

Using multiple choice questions is a great way to provoke divergent thinking, but it should be supplemented with short answer or essay tasks, so the students can further explain the different possible solutions and ideas.

## **SETS**

This type of task can encourage divergent thinking by listing a few answers and students have to decide whether they are possible solutions to the described problem. In Figure 4.2, we present an example of how to use sets in the topic of sustainability.

## **SHORT ANSWER/ESSAY**

The best way to nurture problem-solving skills is by following the PBL methodology. Students can use Redmenta at the end of their project to write down their problem-solving process. It helps their metacognitive awareness and also emphasizes the journey and the way of thinking instead of the actual outcome.

### **Figure 4.2**

*How to use sets in the topic of sustainability.* ►

Which of the following ideas could be possible solutions to reduce the overusage of plastic?



GOOD IDEA



BAD IDEA

2 / 10

Using cloth bags.

Restart

Undo the previous step



# 05

# COMMUNI- CATION

**What should we know about communication skills?**

**How to develop communicative skills at school?**

- *Creating reflective environment*
- *Mobile phone compatible tasks*
- *Using videos*
- *Using open-ended questions in the comprehension process*
- *Nurturing collaboration*

**Developing communication skills with Redmenta**

- *Flowchart*
- *Short answer*
- *Video recording*
- *Order*
- *Creative board*

*“One of its essential aspects is to create a connection between two or more people through two-way information exchange, enabling the activation of other 21st-century competencies.”*

*—Chalkiadaki*

# What should we know about communication skills?

Communication is part of our everyday life, it makes life work <sup>[47]</sup>. Its role is to effectively articulate, receive, understand, and express feedback to facts, thoughts, opinions, feelings and attitudes <sup>[48]</sup>, which can be conveyed verbally, in writing, visually, through the use of technology, or non-verbal communication from the person giving information to the person receiving it <sup>[49]</sup>.

**Communication comes from the Latin word communis, which means common. One of its essential aspects is creating a connection between two or more people through two-way information exchange, activating of other 21st-century competencies <sup>[50]</sup>.**

One of the main goals in education is to master effective oral and written communication <sup>[51],[52],[53]</sup>, which includes four main areas: speaking,

reading, writing, and active listening skills (see: Figure 5.1.). Acquiring effective communication skills gives students an advantage in school and later in academic or work environments <sup>[50]</sup>. Since these skills are closely related to cooperation skills, they are essential to effective work performance <sup>[54]</sup>. Mastering high level of communication skills helps to articulate ideas clearly through speaking and writing, contributes to understanding, making a compromise and supports shared responsibility <sup>[55]</sup>. Moreover, individuals with excellent communication skills tend to lead more successful lives personally and professionally than those who do not have these skills <sup>[56]</sup>.

**Figure 5.1**  
*The modalities of communication*



# How to develop communicative skills at school?

Developing communication skills has long been a part of education; however, using digital technologies broadened the possibilities of well-proven methods. The role and opportunities of learners have been transformed, giving them greater autonomy in the learning process and helping introverted learners to develop their abilities, as they are less stressed by the digital learning environment and thus perform better in fluency, accuracy, and confidence <sup>[57]</sup>. In Figure 5.2, we present certain aspects of the listening sequence to underscore its significance in fostering communication skills in education.

## CREATING REFLECTIVE ENVIRONMENT

One of the most effective teaching strategies for developing communication skills is to create a reflective environment in language lessons. Voice and video recording can be effective tools for students to recognize their strengths and weaknesses in communication. When students record a video, they can prepare for it properly. They have time to think about what they have to say, pre-write, rehearse and practice their texts, thus improving their accuracy, linguistic complexity, and fluency <sup>[58]</sup>. The students can then evaluate the video recording in small groups and express their opinion on each other's work, thereby practicing how to formulate and receive constructive criticism. Moreover, they can correct their mistakes based on the feedback they receive on the recordings (teacher or peer feedback), helping them to improve their language skills <sup>[59]</sup>.



**Figure 4.2**

*The listening sequence*

- Real time processing of the input
- The purpose is important:
  - Listening for gist
  - Listening for detail
  - Inferring



- Activate student's previous knowledge
- Getting students interested in the topic
- Give students a purpose for listening
- Pre teaching vocabulary

- Checking and summarizing
- Discussion
- Creative responses
- Critical responses
- Information exchange
- Problem solving (using a listening activity to solve a posed problem)

## **MOBILE PHONE-COMPATIBLE TASKS**

Creating worksheets for students that can be completed on smartphones is another effective strategy in developing communicative skills, especially in terms of vocabulary development and grammar practice. As mobile devices are available to learners almost anywhere and anytime, practicing grammar tasks has become part of their daily routine <sup>[60],[61]</sup>.

## **USING VIDEOS**

The use of digital tools has brought significant progress in the development of listening skills, as there are plenty of native-language videos available online <sup>[62]</sup>. However, these videos can only be helpful if students are given appropriate tasks to do with them, so teachers need to integrate video content into the curriculum and plan lessons and tasks consciously <sup>[63]</sup>.

Using these videos, students and teachers can solve several difficulties that occurred previously in listening skills development. When learners do not understand the speaker, who is speaking too fast, cannot follow the video, or they get tired or need

to listen to something more than once <sup>[64]</sup>, it is possible to stop the text, rewind it or slow down the pace of speech <sup>[65]</sup>. Using podcasts and vodcasts also could be an effective strategy for developing listening skills in foreign language learning <sup>[66]</sup>. Beside developing listening skills, using podcasts and vodcasts in education could improve students' pronunciation and vocabulary <sup>[66]</sup>.

## **USING OPEN-ENDED QUESTIONS IN THE COMPREHENSION PROCESS**

All communicative skills can be developed at the same time if listening /reading comprehension texts are not only processed using single-choice and multiple-choice tasks but also by using open-ended questions. An open-ended question cannot be answered with yes/no, or with a few words; it requires more ideas, moreover it allows learners to creatively formulate their own opinions about the text and use their own expressions and words in their answers <sup>[67],[68]</sup>. It is also an effective way to measure students' understanding <sup>[69]</sup>.

In addition to the reading comprehension task, the answers to the open-ended questions can be discussed later verbally, thereby allowing teachers

to inspire discussion and show students that there is more than one good answer to a question, as it can be interpreted from many perspectives.

## **NURTURING COLLABORATION**

Collaborative-work tasks are also an excellent way to develop students' verbal and written communication skills. In class, students can make a joint presentation or video, which they can later show to their peers. While preparing the product, they can discuss some questions and look for answers to the problems that arise. During the discussions, they can also learn how to become active listeners, formulate questions about topics they do not understand, and how to reach a consensus for a common goal. Collaborative work can also result in a digital essay, developing several 21st century skills <sup>[70]</sup>. Students can read aloud the completed essays, analyze and reflect on each other's writings. In this way, students learn to recognize and appreciate good writing by working on their own and others' work. They also can improve their own work based on teacher and peer feedback. Research has shown that interactive feedback has helped learners to develop their writing skills more effectively. After implementing the

suggested changes to their writing, they became more confident and noticed improvements that served as a motivating force for them <sup>[63],[71]</sup>.

# Developing communication skills with Redmenta

The variety of tasks in the Redmenta educational platform offers teachers many opportunities to develop students' communication skills in a complex and effective way.

The different task types allow for differentiation, i.e., several worksheets can be easily prepared on the same topic. The already completed exercises can be saved individually, reused several times, and varied with each other, so that the worksheets can be created considering the student's various needs and interests.

As both a text and an audio file can be uploaded for a certain task, the platform also offers the possibility to support the skill development of learners with special needs <sup>[72],[73]</sup>. Moreover, as it greatly helps students in independent learning, it can be very effective for learners who receive little help at home due to their lower socioeconomic status <sup>[74]</sup>.

The simultaneous use of the audio file and the text provides both verbal and visual stimuli, and simultaneous reading with the audio helps to develop reading skills <sup>[75]</sup>, while it can also help in developing students' pronunciation.

In the Redmenta interface, video recording and essay assignments allow for a reflective classroom environment where students can work together on a video, video presentation or essay (using one computer together), and then jointly evaluate and improve it. In addition to the traditional multiple-choice and gap-filling tasks, creative task types (Flow chart, Creative board) help widen the possibilities of the reading/listening comprehension tasks. In the following, we show some concrete examples of how tasks and functions in the Redmenta educational platform can be used to develop communication skills.



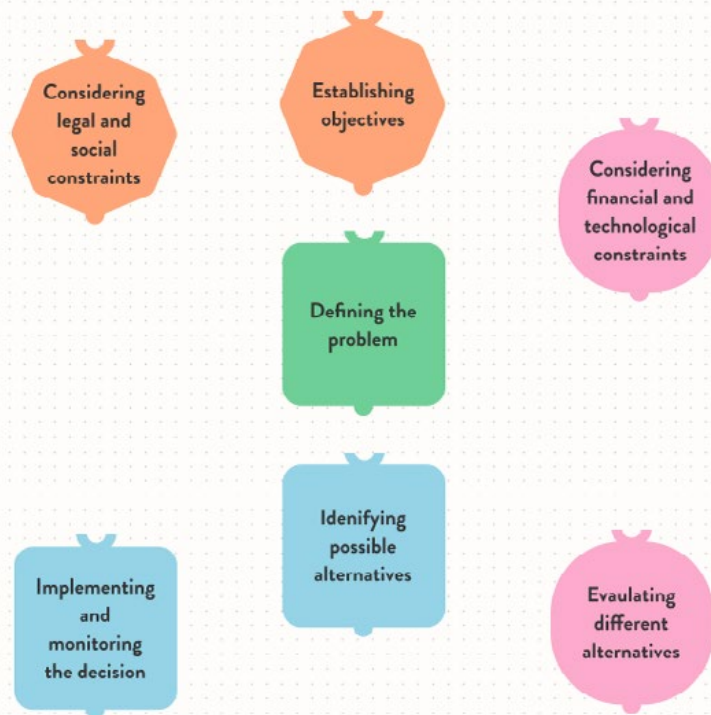
## FLOWCHART

This type of task allows students to represent the context of a text visually. The task helps to process and understand the details, connections, and relationships in the text, and can also be used as a test of reading comprehension. A flowchart can be used, for example, to display the relationship between actors in the processed text, or assign events to different locations or times (See Figure 5.3).

### **Figure 5.3**

*An example of using Flowchart to develop communicative skills* ▶

## Create a Flowchart of the managerial decision making process!



## SHORT ANSWER

Communication skills can be developed by giving short answer options in comprehension tasks. Suppose this type of task is used in comprehension tasks, and open-ended questions are formulated for the students, they do not have to choose from a set of ready-made answers but can create their own short answers. In this way, a question can have several good answers, reflecting the learners' personality, perspective, and knowledge (see Figure 5.4.). This exercise is also an excellent way to help learners to recognize, through joint checking and discussion, that there can be more than one good answer to a question from different perspectives.

**Figure 5.4.**  
*An example of creating  
a short answer task*



**How do we know what season it is? (You can write more than one answer. Every appropriate answer is worth one point. You can get 6 points maximum.)**

 Answer 1 : From the fact that the text begins: the fall is almost over.

Answer 2 : There aren't any leaves on the streets.

Answer 3 : A hare would only jump for an apple if it was hungry. In the autumn, it doesn't find so much food. That's why it needs the apple.

Answer 4 : Apple is an autumn fruit, there are no ripe apples on the tree in the other seasons.

36/230-250

## VIDEO RECORDING

Video recording tasks can be used to develop students' speaking skills. One of the advantages of this task is that the students can record the video several times, improving it based on their self-reflection and feedback from the teacher or their peers. Another advantage is that students can prepare for the recording in advance, and it makes them more confident in speaking and improving their fluency and accuracy. Students can create video recordings on different topics: it can be used as a part of an oral test, they can tell stories by this, they can make a presentation, and they can also prepare for example a lawyer's defense speech, which could later provide a great start for a debate.

With the video recording task, students can also learn how to talk about a topic in a focused way and in a given time. If this is the purpose of the task, teachers should specify how long a student can talk about a topic. The video recording task in the Redmenta task sheet has a feature that allows them to set the maximum length of the video recording. The task becomes even more challenging if teachers keep reducing the allowed length of the recording, with the caveat that the explanation of the topic must be clear and the essential elements must be included.

## ORDER

This type of task is helpful in developing reading or listening comprehension skills by asking students to sort the given sentences in chronological order according to the content of the text (Figure 5.5.) The task also can be used to check comprehension, and can be linked to additional tasks to develop further communication skills. For example, it can be used as the basis for writing an essay related to the text, or as an aid for students to summarize the text's content verbally.

### **Figure 5.5.**

*An example of using Order task to develop communicative skills* ►

**Please put the sentences into the correct order.**

☐☐ Hare saw an apple on an apple tree and tried to get it, but it was too high.

☐☐ Crow picked the apple off the tree and flew away.

☐☐ Hedgehog ran away with the apple.

☐☐ They started to fight for the apple.

☐☐ Crow pecked Hedgehog on the snout.

☐☐ Hedgehog pricked Hare on the leg.

☐☐ They screamed so much so they woke up the Bear.

☐☐ They explained Bear the situation.

☐☐ Bear gave them some good advice.

☐☐ Hedgehog divided the apple into 4 parts.

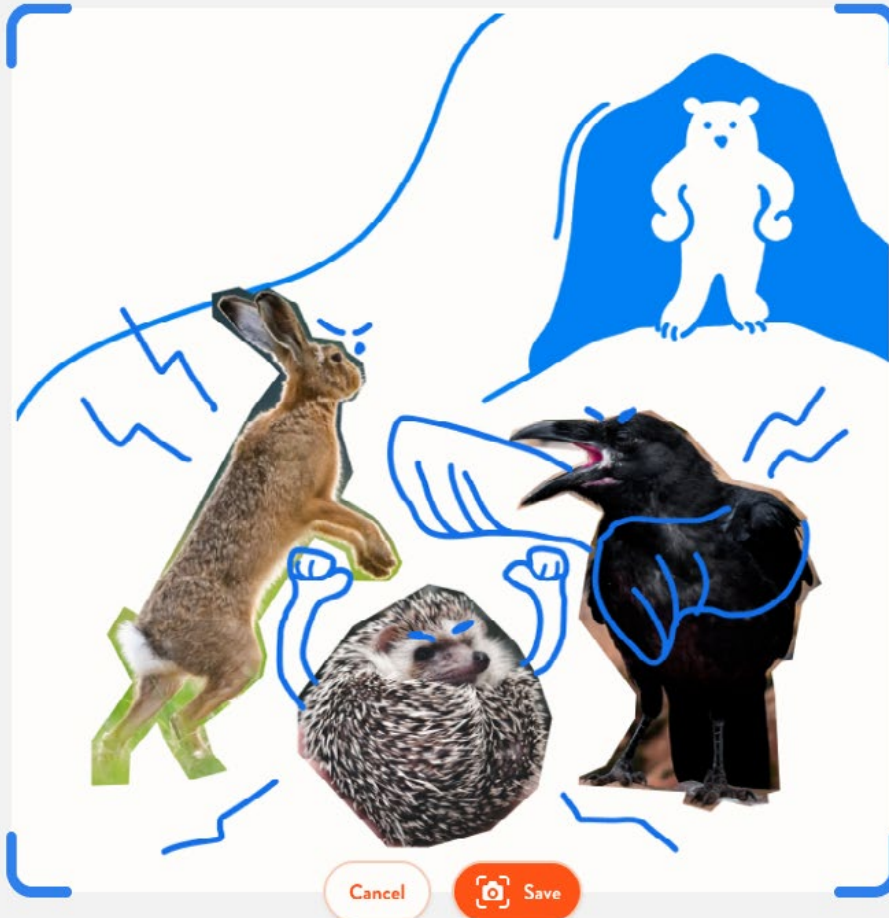
## CREATIVE BOARD

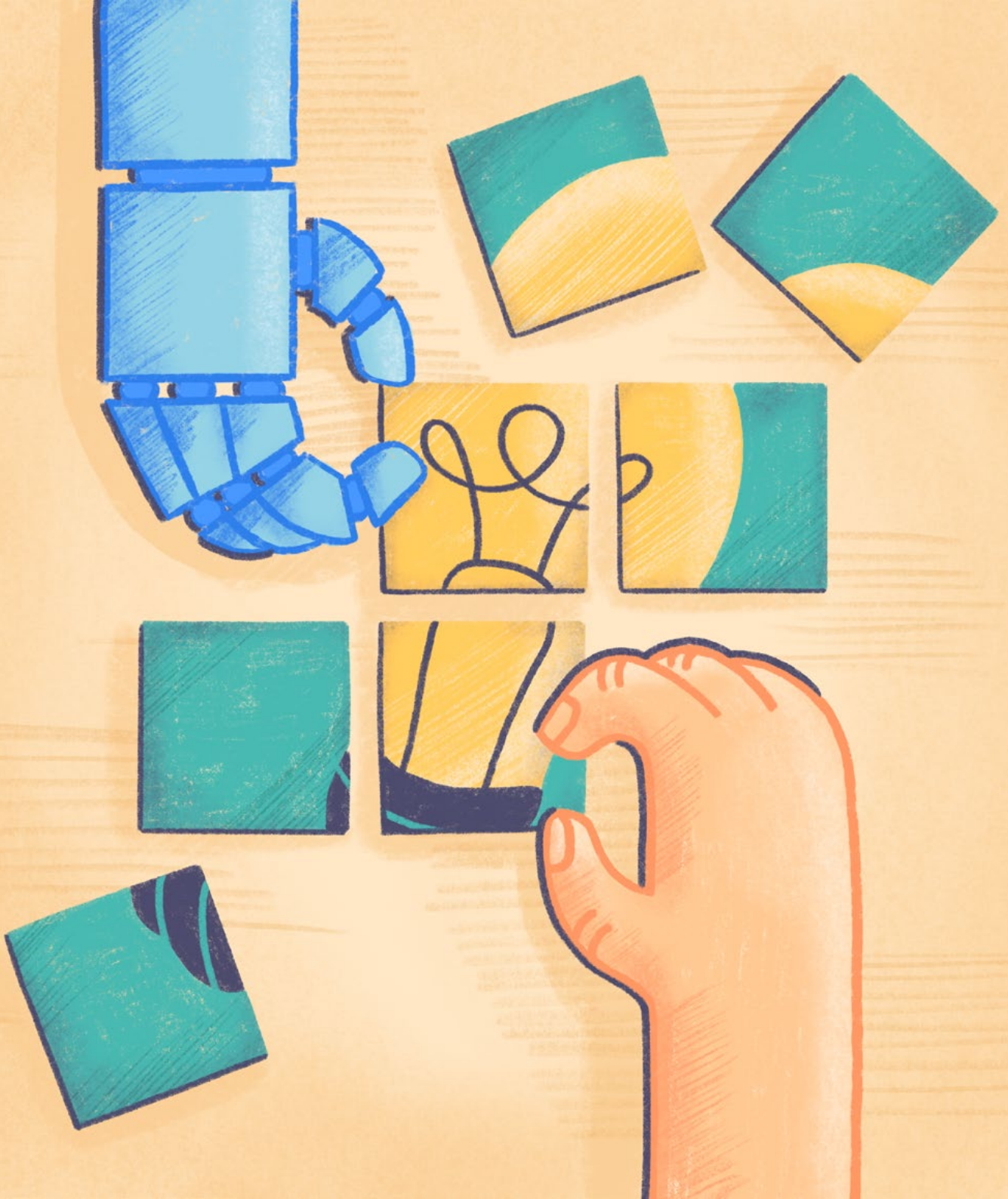
Creative board task can be used in several ways in developing or checking students' reading comprehension skills. It is an effective tool to help visualise the story flow. Teachers can cut out small scenes (text passages) from the main text and give the students the task of drawing the content of the text in as much detail as possible (see Figure 5.4.). This way teachers could check if the students have understood the text. If every students get different parts from the text, later the artwork of the students can be arranged in a series to create a digital picture book. In addition to the sense of achievement, this digital picture book can help those students who have reading difficulties to understand the whole text by dividing the entire text into smaller units and illustrating the content.

### **Figure 5.6.**

*An example for a Communication related task using Creative Board* ▶

Make an illustration for the following short story:  
Crow pecked Hedgehog on the snout. Hedgehog pricked Hare on the leg. And Hare yanked Crow's feathers. They screamed and shouted so much so they woke up Bear.





# 06 SUMMARY

*“The learning environment should encourage inquiry, discussion and collaboration among students.”*

*—Byrnes & Dunbar*

**In the 21st century, developing higher-order thinking skills can be challenging for teachers. The most practical way of integrating the nurture of these skills into formal education is to do it by creating complex tasks that involve multiple developmental fields at once. In this white paper, we introduced four skills that became essential.**

We have shown that creativity is an essential skill to prosper in everyday life [6],[11], therefore, the nurturing of creativity should be a highlighted task for every educator. Creativity means new, original and useful ideas [13]. The generation of creative ideas takes time, and teachers can use Redmenta as an online journaling tool to help students throughout the whole creative process. The assessment of creativity can be really challenging, but a possible solution might be giving bonus points for ideas that are original and special in addition to the maximum points after they assign the worksheets. In order to develop creativity in students, teachers also have to think and teach creatively, and then their creative

practice could result in an engaging and safe learning environment.

We also presented the importance and development opportunities for analytic thinking. It is a valuable skill in daily life as it helps individuals process complex information, make informed decisions and communicate effectively. To develop analytic thinking in school, teachers can create tasks that require evaluating information and arguments or provide methods for analyzing problems (e.g. mind-maps, questioning). The learning environment should encourage inquiry, discussion and student collaboration [29]. Educational technology and technology-based assessments can be used to assess and develop students' skills. Assessments such as true or false questions and matching questions can be used to test analytical skills. Redmenta offers various tools to foster analytic thinking, we can create task with graphic organizers, including flow charts and creative boards.

Problem-solving is inevitable in our lives since it is a behavioral process that consists of gathering potentially effective responses to a problematic situation by using divergent thinking skills and creativity and then choosing the most effective



one<sup>[10]</sup>. The keys to nurturing this skill in the classroom environment are using ill-structured problems, encouraging multiple solution paths, and accepting several solutions as the “right” answer<sup>[42]</sup><sup>[43]</sup>. Redmenta can be a helpful tool for teachers if they want to use process-oriented evaluation by using the worksheet as an online journal to record the problem-based learning process or by using the tasks to boost children’s divergent thinking skills.

We would also encourage teachers to nurture communication skills since they make a significant contribution to people’s intellectual development, academic achievement, job success, career development and ability to adapt to change<sup>[76]</sup>, therefore, the improvement of these skills has long played an essential role in education. By using digital tools, this process can be extended and made more efficient. The four communication skills do not develop separately they can be developed most effectively in relation to each other. The wide range of varied tasks in Redmenta enables teachers to develop communication skills in a complex way, tailored to the students’ individual needs, while motivating them and creating the conditions for their independent learning.

These higher-order thinking skills can be nurtured at once if we create and combine tasks that focus on multiple developmental fields. Creating complex worksheets today is less challenging, thanks to digital technology. Redmenta can be an excellent tool for developing creativity, analytic thinking, problem-solving, and communication at the same time if it is used properly and with this goal in mind. This white paper was made to guide teachers who want to focus on the development of these inevitable areas in their practice by introducing previous empirical evidence and specific showing examples with Redmenta. The paper also helps teachers with difficulties that might arise while applying these ideas, such as the problem of evaluation. In this summary, we provide complex worksheets that have been integrated into the chapters of this book.



Ultimately, we aim for this white paper to assist teachers in sparking their students' engagement in skill-building, and for teachers to utilize the information to design engaging and enjoyable worksheets through Redmenta.



<https://redmenta.com/savetheplanet>

Jumper: savetheplanet



<https://redmenta.com/digcompsafety>

Jumper: digcompsafety



<https://redmenta.com/let'sstalkaboutanapple>

Jumper: let'sstalkaboutanapple

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