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List of acronyms

Acronym	Description
4Cs	Creativity, Critical thinking, Communication, Collaboration
AI	Artificial Intelligence
augMENTOR	Augmented Intelligence for Pedagogically Sustained Training and Education
AUT	Alternate Uses Task
CPS	Collaborative Problem-Solving
CT	Critical thinking
EU	European Union
H-H	Human-to-Human
H-A	Human-to-Agent
OECD	Organisation for Economic Co-operation and Development
PISA	Programme for International Student Assessment
TTCT	Torrance Tests of Creative Thinking

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Executive summary

The development and assessment of transversal competencies, focusing primarily on creativity but also including critical thinking, collaboration, and communication, aims to support the learners' and educators' development. In this deliverable, the assessment of the 4Cs competencies aims to support the learners engaged through the Horizon augMENTOR project. Evaluating transversal competencies is not a straightforward or linear process. These skills are not static; they evolve and adapt to different contexts and challenges. Therefore, traditional assessment methods may fall short in capturing the full spectrum of an individual's transversal competencies. To effectively assess these competencies, our project employs a multifaceted approach that has been defined through a participatory methodology. During the 4Cs workshops, defining the pilots' strategy to evaluate the 4Cs, the initially proposed tools for the assessment of critical thinking through Argyris and Schön's (1978) double-loop learning cycle model and the use of CoCreat for creativity in a collaborative context, has been considered less adapted to the context of the pilots. Following these participatory workshops within the pilots (WP6), the pedagogical framework (WP3), and the 4Cs (WP4), we have reached a consensus on the use of rubrics as the most adapted method to evaluate the 4Cs. The consensus of the 4Cs assessment workshops led to the focus on the rubrics as the augMENTOR common methodology for the assessment of the 4Cs, based on the identification of three components for each of the 4Cs. In this deliverable, we introduce the methodology followed for the definition of common components for each competency and the way they adapt for each pilot (WP6) and the augMENTOR pedagogical framework (WP3), based on sociocultural approaches such as activity theory.

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1 Introduction

1.1 Objectives

This deliverable has two main objectives.

- Introduce the transversal competencies and describe the augMENTOR's assessment of them (Objective 1)
- Integrate additional strategies to support the assessment of transversal competencies (Objective 2)

To address these objectives, we performed a literature review on the main components of each of the 4Cs, and then proposed the key components identified for the evaluation of the 4Cs. Finally, we propose additional strategies for the assessment of transversal competencies.

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2 Defining transversal competencies

Transversal competencies refer to abilities that transcend any one particular area of knowledge and give users the ability to adapt, innovate, and problem solve in various environments and challenges. These competencies have been identified in a number of frameworks including the OECD's definition of key competencies (OECD, 2019) as well as the Partnership for 21st century learning's P21 framework as higher-order reasoning skills essential to success in the new innovation economy. Incorporating skills such as critical thinking, problem solving, teamwork and adaptability, transversal skills are often distilled to the core competencies of communication, collaboration, critical thinking, and creativity or the 4Cs (D4.1). While the use of 'skills' and 'competencies' is frequently interchanged when describing these transversal skills, it should be noted that a distinction between the two is made in educational settings. Competence is often considered what you do, and competency, how well you do it. Skills are considered part of competence in competency-based education (Argyris & Schon, 1974; Chee Pee, 2011; Romero et al., 2015; Voorhees, 2001). For Westera (2001), "competence is no more than a descriptive term that could easily be substituted with other terms like conditions for successful performance" (p. 7).

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3 Assessment of transversal competencies

For the assessment of transversal competencies, after we conducted an evaluation of the needs of the pilots, we decided to adopt the learning assessment strategy that includes the use of rubrics. The use of a rubric is the result of two participatory workshops with the augMENTOR pilots for defining a contextually relevant approach for the assessment of the transversal competencies. A rubric is an assessment tool that consists of the definition of the criteria that are evaluated within a task or skill and the levels of achievement or fulfillment of these criteria. This info is structured in a table. The first column of the table consists of the criteria that will be taken into consideration to carry out the assessment, and in the first row we've got the levels of achievement. To each of these levels we assign a numerical score. In each cell of the table, we explain the qualities that the learner's work should possess in order to be assigned the particular level and score. Rubrics permit to structure the observations permitting to assess a competency. Rubrics permit to align learning objectives with the teaching strategy more precisely. Rubrics can be used to increase transparency: an educator can defend or support their evaluation in the event of any concerns. Rubrics can also support learners' auto-evaluation and learning regulation (Panadero et al., 2023; Panadero & Romero, 2014). Learners can develop their awareness on what they need to do and what the educator wants. Rubrics guide learners and let them know what to work on. The integration of rubrics in Moodle[1] and TryHackMe[2] (pilot 4) can support students taking responsibility for their learning if the rubrics are made available for them prior to the learning activity. Rubrics can also promote co-evaluation with and between learners and the exchange of opinions.

Following the alignment strategy designed and implemented by the augMENTOR pedagogical framework, each pilot who will employ this assessment logic with rubrics should incorporate such an approach into every activity that evaluates the learners. Doing so will, additionally, ensure the collection of data required for the assessment of the 4Cs for the augMENTOR solution.

3.1 Generic and specific components of 4Cs assessment in augMENTOR

When evaluating the 4C competencies, Critical thinking; Communication, Collaboration and Creativity, it is important to distinguish the differences between their specific and generic aspects. For each competency we define three components. At the component level, specific aspects refers to a learner's ability to demonstrate a particular competency

[1] https://moodle.org/

[2] https://tryhackme.com/

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component within a given context or framework (e.g. innovation in the context of text writing or innovation in the context of creating a digital artefact). Conversely, the generic aspect refers to common aspects of the competency that can be observed across a number of different scenarios and domains. The distinction between these two aspects is key to fully understanding and assessing the 4Cs in educational contexts.

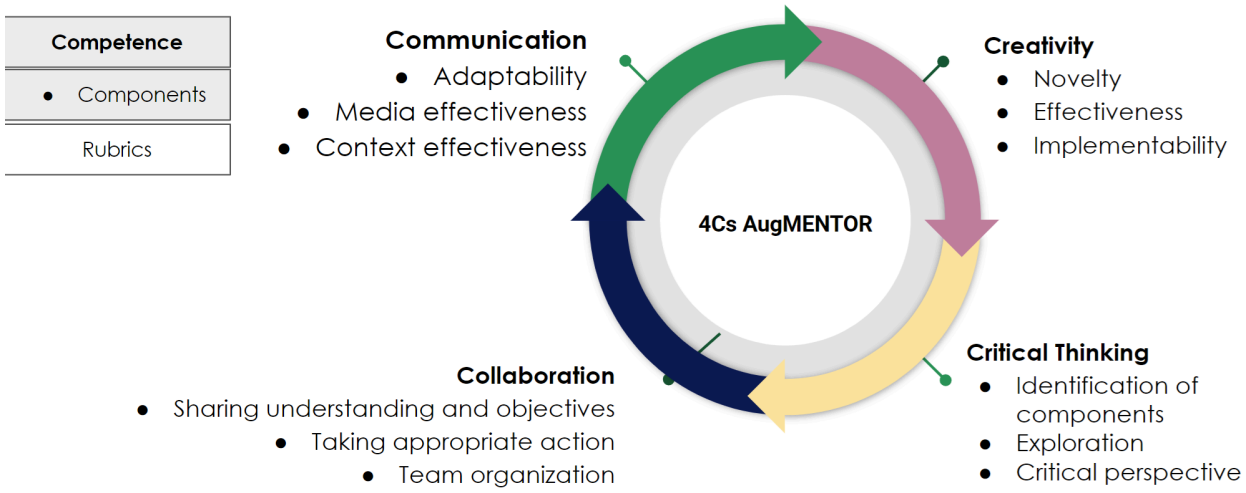

Figure 1. *4Cs and generic components*

4 Assessment of creativity

When creativity is discussed, there is often reference to individual work related to the arts, often in relation to different traits of personality (Brown et al., 1989; Guilford, 1970; Fleming, 2010). Even in educational contexts, creativity has been assessed mainly by focusing on individual activities (Jones, 2009; Katz-Buonincontro & Anderson, 2020). However, the definition of creativity is not restrictive regarding the context of expression. Indeed, creativity can be described as an ability to develop a solution that is new, original, and contextually appropriate (Lubart et al., 2015). In order to propose a creative product, the individual(s) must perform a succession of thoughts and actions involving several cognitive processes (divergent and convergent thinking, inhibition, ...). Moreover, each individual has their own creative potential. This individual's potential can be impacted by different factors at the individual and societal level (knowledge, personality, motivation, emotions, culture, family, school...) that interact with each other and can be expressed more or less in all areas of life. As it develops, the creative potential becomes a means of solving problems, bringing with it the ability to question, communicate, etc., contributing to the creation of a positive climate, awakening to art and even contributing to a certain openness of mind. As a result, fostering creativity in educational contexts is important.

For identifying the key components of creativity, we develop a literature review of the studies in creativity assessment and then we select the components that are more adequate considering the factors related to the competency components.

In defining creativity, Sternberg (2022) argues that typical definitions have been emphasized into two components: novelty and something typically identified as usefulness, effectiveness, or value. These components are indeed reflected in the definitions provided by various scholars when they define creativity as the ability to produce ideas or solutions deemed original and beneficial within a specific context (Plucker et al., 2004; Runco & Jaeger, 2012; Smith & Smith, 2010; Amabile et al., 2018). The shared definitions around creativity by many scholars may be rooted in Guilford's model (Long et al., 2022). Guilford (1967) divided creativity into 8 types: flexibility, fluency, novelty, analysis, reorganization, redefinition, synthesis, complexity, and elaboration. In addition, Guilford considered divergent thinking and convergent thinking as two significant components of creativity.

Hommel et al. (2011) referred divergent thinking as the ability to produce a wide range of novel solutions within weakly defined constraints, offering numerous alternative solutions to a problem from which the optimal one is chosen; while convergent thinking refers as cognitive

process in which individuals integrate knowledge and use rules or processes to get the best answer to a given situation.

In the education field, the assessment of creativity can be perceived as an attempt to recognize creative strengths and potential among learners by identifying abilities, solutions, and synthesis in various domains (Kim et al., 2019). Divergent thinking is considered the most used approach to assess creativity (Wechsler et al., 2018) since it involves parts of creativity's components that offer an understanding of an individual's exploration of thinking towards multiple solutions (Wang et al., 2017). When explaining divergent thinking, Guilford (1967) introduced as well Alternate Uses Task (AUT) where he presented audiences with a basic object, such as a pen, and asked them to think of as many applications for the item as they could. The findings then are generally scored based on several types: responses (fluency), various categories employed (flexibility), the degree to which the responses branch out from the standard or group mean (originality), and detail's responses (elaboration) (Hommel et al., 2011). Furthermore, Wechsler et al. (2018) pointed out that the components that Guilford's AUT proposed influenced as well the most widely used tests called Torrance Tests of Creative Thinking (TTCT) by Torrance (1981).

Based on the divergent thinking components (focusing on **novelty**) and the convergent thinking (**effectiveness** and **implementability**) components we focus on three main components which are **Novelty, Effectiveness and Implementability**.

For the assessment of creativity we focus on three main components :

- **Novelty** is defined as the newness and uniqueness of a process or a solution developed by the subject.
- **Effectiveness** is defined in relation to the functionality of the creative process or product within a certain context and task in order to support the progress or improvement within the task.
- **Implementability** focuses on the capacity of the idea and the availability of resources required to be integrated in a certain context in which the idea is implemented.

Shah et al. (2003) referred to novelty as the ability of producing ideas or solutions that are unique, groundbreaking, and depart from conventional norms. As it embodies the essence of uniqueness and new perspectives, novelty becomes one of the key components of creativity, encouraging innovative thinking (Sarkar & Chakrabarti, 2011). Novelty ensures that creative outputs stand out, capturing attention and inspiring further exploration, making it a vital aspect in the multifaceted landscape of creative expression and problem-solving (Sternberg & Lubart, 1998; Amabile et al., 2018).

In addition to novelty, (Sternberg, 2022) mentioned another creativity component that is commonly associated with usefulness, effectiveness, or value; he emphasized that although those three factors are not similar, they all relate to the functionality of an idea that is generated. Therefore, in utilizing the "effectiveness" of augMENTOR's assessment, we focus on incorporating definitions of usefulness, effectiveness, or value that have been described by scholars where its attention is on functionality of the creative process or product within a certain context and task. For instance, Amabile et al. (2018) mentioned that an idea or product is considered to be creative when it is both novel and valuable in the perspective of relevant observers; their implied value as an idea or other contribution must be directly relevant to the goals. Value and novelty are almost often taken into account simultaneously, perhaps because a lot of research appears to assume novelty increases the value of a solution (Gruys et al., 2011).

Baer (2012) highlights that idea implementation in the creative process involves transforming ideas into new and improved products, services, or methods, thereby making innovation as a dual process involving the development of novel and useful ideas and their implementation. Perry-Smith & Mannucci (2017) pointed out that while the generation of novel concepts is essential, their effective implementation is equally vital for the manifestation of innovation; it bridges the gap between ideation and impact, ensuring that creative endeavors contribute meaningfully into actionable and valuable results. Implementation requires also to consider the availability of resources to integrate the creative process or product in a certain context or task.

Within the augMENTOR project, **creativity** is assessed based on these components:

- Novelty
- Effectiveness
- Implementability

In the annex 1, the specific operationalisation of criteria for each of these three components of the creativity competency is presented for each of the augMENTOR pilots.

5 Assessment of critical thinking

Critical thinking (CT) is acknowledged as a vital competency for success in contemporary society, influencing problem-solving, adaptability, and academic achievement. Despite lacking a universally accepted definition, scholars like Black et al. (2008) characterize CT as meticulous and rigorous analytical thinking. Its multidimensionality and domain specificity pose challenges to a concise definition. The American Philosophical Association links optimal critical thinkers to qualities like curiosity and adaptability. Creativity and CT are interconnected and often developed simultaneously. Recent clarity in the definition of CT emphasizes its role in assessing the epistemic quality of information, influencing well-informed decision-making. CT is also crucial for identifying and mitigating cognitive biases. Age-specific elements in CT development highlight its relevance from primary education to late adolescence, with measurable skills outlined by (Facione, 1989, 2011). These skills collectively underpin effective critical thinking.

For the assessment of critical thinking we focus on three main components :

- **Identification of components:** Recognizing or identifying a problem is integral to critical thinking as it represents the foundational step in the process of evaluating and analyzing information (Philley, 2005). In critical thinking, individuals must first recognize and articulate the central concepts or key points within a given context (Halpern, 2006). During the first stage of the critical thinking process, (Garrison et al., 2001) describe a phase called "triggering" as a situation when problems emerge and an individual is able to identify or recognize the existing problems. It is during this phase that socio-cognitive processes such as the presentation of background information build up to pose a query. Facione (1989) also notes "interpretation" as a process "*to comprehend and express the meaning or significance of a wide variety of experiences, situations, data, events, judgments, conventions, beliefs, rules, procedures or criteria*" (p. 13). The ability to identify a problem and process it to an idea lays the groundwork for critical thinking; without a clear grasp of the central concepts, critical thinkers would struggle to engage in meaningful examination and assessment of information (Philley, 2005).
- **Exploration:** In this dimension, critical thinking engages the learner in the analysis of different ideas and perspectives. The exploration of ideas is based on the principles of *critical analysis*. This engages the learners in the scrutiny of expressions designed to articulate different types of information (beliefs, judgements, experiences, reasons, opinions, hypothesis) and to explore these different ideas in order to relate them to the context in which they have been developed. The exploration of ideas within critical

thinking competency requires individuals to evaluate the type of expressions, but also to consider them in context of one another through a comparative process. This comprehensive exploration serves not only to enhance understanding, but also serves to cultivate a deeper understanding of the dynamic interplay of ideas within the context of analysis.

- **Developing a Critical Perspective:** Elmouhtarim (2018) observes that developing critical thinking skills is one of the most important skills of the 21st century. One effective way to cultivate critical thinking skills in 21st century learning is through the implementation of learning activities designed to enhance these abilities. According to (Facione, 1989), critical thinking uses a comprehensive approach to analytical reasoning, problem-solving, and information evaluation. The use of a problem-based learning (PBL) approach is thus one of several frameworks aimed at developing learners' critical thinking skills. Facione and the experts participating in the Delphi study concurred that interpretation, analysis, assessment, inference, explanation, and self-regulation are all crucial components of effective critical thinking. Together, these skills provide the basis of developing critical opinions or ideas. Additionally, Black et al. (2008) see critical thinking as analytical reasoning fundamental to rational discourse and inquiry. It emphasizes a meticulous and rigorous approach, specifically concentrating on the processes essential for rationality. These processes encompass analyzing arguments, assessing the relevance and significance of information, evaluating claims and explanations, developing clear arguments, and forming well-reasoned judgments. Being rational also necessitates maintaining an open-minded, but critical stance towards both one's own thinking and that of others. Moreover, requiring analysis, evaluation, and elucidation of one's own thinking, being rational aims for greater internal coherence in one's reasoning. Black et al. (2008) also argue that effective critical thinking is demonstrated through rigorous and meticulous thought processes. It is an active, careful, and thorough approach, distinct from being passive, automatic, spontaneous, or reactive. Critical thinking is recognized as a specific competency to be developed in educational settings.

In the augMENTOR solution, **critical thinking** is operationalized according to three main components:

- **Identification of components**
- **Exploration**
- **Critical perspective**

In the annex 1, the specific operationalisation of criteria for each of these three components of the **critical thinking competency** is presented for each of the augMENTOR pilots.

6 Assessment of collaboration

Wishart and Eagle (2014) argue that mere creativity is no longer enough in today's world. Indeed, important creations are almost always the result of complex collaborations, suggesting the need for collaboration in the creation of novel and innovative solutions (Sternberg, 2015). Collaboration is considered one of the broad range of skills necessary for learners navigating today's world (OECD, 2019). Its importance can be ascertained by its inclusion as one of 21st Century Skills (Binkley et al., 2012). In addition, international assessment such as PISA also include collaboration in their assessment of creative thinking, recognising collaborative skills as an important internal resource (or described as "individual enablers") of creative thinking (Foster & Schleicher, 2022).

Collaboration is a dynamic process with a multi-level nature that is not easily measurable in group or team inputs and outputs (Thornhill-Miller et al., 2023) Hence, thorough approaches are required to properly measure them. In 2015, PISA's assessment identified three types of collaborative components, which became the foundation of creative collaboration for Horizon's augMENTOR project assessment of collaboration competency. The three competencies that we assess are based on PISA's proposed components: (i) Sharing understanding and objectives, (ii) taking appropriate action, and (iii) team organization (OECD, 2017). These competencies are synthesized with problem-solving competencies as illustrated in PISA's previous assessments: exploring and understanding; representing and formulating; planning and executing; and monitoring and reflecting.

- **Sharing understanding and objectives**: This component considers the identification of team member abilities, the capacity to build a shared representation of the problem, the communication between team members, and the monitoring of the shared understanding. The team which builds a shared representation of the problem will actively engage in transactive discourse, i.e., constructive communication between members which requires awareness of the knowledge and expertise of other members, reducing the collaborative cognitive load. The learner model reported in D3.3, monitors collaboration in terms of the perceived collaborative cognitive load and transactive discourse which provides an additional point of reference for this component.
- **Taking appropriate action:** Identifying potential solutions, applying them, and monitoring their progression in order to solve the problem.
- **Team organization:** Identifying the roles and distributing tasks, while monitoring the organization and individual roles.

In addition to the framework suggested, our assessment proposal incorporates the collaborative assessment approach of the 2015 PISA exam, which utilised technology to

facilitate the evaluation of learning analytics. As part of the PISA 2015, participants undertook tasks while interacting with computer-based conversational agents. The results indicated how PISA 2015 was able to assess the collaboration performances of participants (OECD, 2017).

While the utilization of technology in assessing collaboration demonstrates potential, a number of aspects of the assessment require further investigation. Shaw and Child (2016) raise the issue of how PISA 2015 was limited in its ability to evaluate participants' communicative strategies finding that, while the use of agents can increase the reliability and standardisation of these types of assessments, they may also oversimplify the nuanced interactions that occur in Human-to-Human (H-H) collaborations. This highlights a potential disparity between participants' real-life responses and their reactions to assigned tasks utilising Human-to-Agent (H-A) interactions. Herborn et al (2020) also acknowledged the standardisation and interpretive benefits that come from H-A interactions, but noted that H-H interactions produced a larger number of overall actions.

Hence, while there may be concerns about the authenticity of the use of agents, there is still potential in leveraging technology to assess collaboration, particularly in assessments at scale. Beyond the already mentioned benefits of standardisation and reliability, Herborn et al. (2020) found no major difference in the collaborating partner types, while Rosen and Tager (2013) found that students assessed on their Collaborative Problem-Solving (CPS) skills using agents outperformed H-H interactions, showing higher levels of both shared understanding and feedback.

Based on the revision of collaboration assessment based on PISA, for the Horizon augMENTOR project assessment of **collaboration** we focus on three main components :

- **Sharing understanding and objectives**
- **Taking appropriate action**
- **Team organization**

In the annex 1, the specific operationalisation of criteria for each of these three components of the **collaboration competency** is presented for each of the augMENTOR pilots.

7 Assessment of communication

The National Education Goals Panel, established under the "Goals 2000: Educate America Act" in 1993, decided to create an assessment system showing the competency of college graduates in demonstrating specific skills, and one of the skills prioritized was a learners' ability to communicate effectively (Newburger, 1995). Programs in the discipline of communication are being assigned with leading institutions in attempts to strengthen communication skills across the curriculum (Allen, 2002; Dannels, 2001).

Dannels notes that once an appropriate rubric is chosen, the assessed skills appropriate for the field of communication, as taught in a general education setting, can be replicated in any discipline (Dannels, 2001).

For successful teaching, adept communication plays a crucial role. Effective integration of diverse teaching pedagogies is imperative to encourage communication between educators and peers. According to Cate and De Haes (2000), Humphris and Kaney (2001), and Van Der Vleuten et al. (2000), there are a number of reasons that have been put forward for communication skills assessment: (1) From an educational standpoint, learners typically give assessments of their learning objectives top priority, downplaying the importance of goals that are not examined on important tests. The focus of doctors in training is greatly influenced by the presence of communication competency in assessments. (2) Receiving feedback on their communication skills through tests helps learners accurately determine their areas of need for learning. (3) It is necessary for staff members to rate these talents in order to assess communication skills. Participating in faculty development encourages them to evaluate their own work, which improves patient care and education. (4) The findings of communication skills assessments provide curriculum planners with information about areas that need work and areas where courses succeed, enabling them to make well-informed changes for improved learner outcomes. Even though it might seem simple, teaching 21st-century learners effectively requires more than just one-way communication. Every profession requires a certain level of communication. In order to prepare learners for the employment demands of the twenty-first century, communication is essential (Van Roekel, 2008).

We focus on three components for the evaluation of the communication competency:

- **Adaptability** - Using communication for a range of purposes.
- **Effectiveness through different media** - Utilizing multiple media according to their effectiveness.
- **Effectiveness in different contexts -** Communicating effectively in diverse environments

Ramachandiran et al. (2016) study highlights that **adaptability** is one of the components of communication assessment by employing communication for various purposes at different levels of use. In certain instances, communication serves purely informational purposes, with no discernible indication of any underlying goals beyond the dissemination of facts. Alternatively, some individuals may exclusively employ communication as a tool for instruction or information sharing, devoid of any broader objectives. On the other hand, there are those who engage in communication with a multifaceted purpose, aiming to educate, inspire, convince, and instruct. This dynamic approach involves harnessing the power of language and expression to achieve a range of communicative goals. Moreover, there are individuals adept at using a combination of verbal and nonverbal communication techniques to effectively convey information, persuade others, instill motivation, and provide clear instructions across various occasions. In such cases, the richness of both verbal and nonverbal elements enhances the communicative impact, creating a well-rounded and influential interaction. (Ramachandiran et al., 2016).

Ramachandiran et al. (2016) propose that communication assessments should employ a comprehensive approach, utilizing various media components based on their effectiveness, which has permitted the consideration of media effectiveness as a second component for the communication competency assessment in the augMENTOR solution. In the evaluation of communication assessments distinct levels of proficiency are discernible among participants tasked with the use of various media and technologies. In the assessment framework of Ramachandiran and colleagues, participants demonstrated varying levels of proficiency in creating a product using diverse media and technologies. At the foundational level (1), there was an attempt to engage in the creative process, but the group faced challenges leading to an incomplete task. The critical shortcoming was a lack of both successful execution and thoughtful evaluation, emphasizing the fundamental principle that both elements are crucial for meaningful outcomes. Moving to the second level (2), another group successfully created a product, yet their approach lacked consideration for the impact and efficacy of the product, highlighting the need for a comprehensive assessment framework. At the third level (3), participants exhibited a heightened proficiency by crafting a product and conscientiously considering its impact and efficacy, showcasing a more sophisticated understanding of the evaluation component. Finally, at the highest level (4), a group not only creatively utilized diverse media and technologies but also meticulously considered the impact and efficacy of the development process. This underscores the importance of a strategic and thoughtful approach to communication assessment, treating the evaluative stage with as much creativity and attention as the initial creative process.

Ramachandiran et al. (2016) study identifies an important component for the communication competency assessment, focusing on communicating effectively in diverse environments. In relation to this component, we can distinguish four distinct levelsAt the foundational level (1), some individuals exhibit a lack of proficiency in cross-cultural communication skills, as they fail to interact effectively in multicultural environments. Moving to the second level (2), others engage in conversations within diverse settings but encounter challenges, indicating struggles in successfully navigating communication in varied environments. The third level (3) highlights individuals who demonstrate proficiency by effectively communicating in multicultural environments, showcasing an ability to navigate diverse cultural contexts during interactions. At the highest level (4), a subset of individuals exhibits advanced skills, effectively utilizing both verbal and nonverbal cues to communicate in diverse settings. This suggests a comprehensive and nuanced approach to communication that extends beyond verbal expression, emphasizing a heightened level of proficiency in diverse communication environments.

Based on the revision of communication assessment, for the Horizon augMENTOR project assessment of **communication** we focus on three main components :

- **Adaptability**
- **Media effectiveness**
- **Context effectiveness**

In the annex 1, the specific operationalisation of criteria for each of these three components of the **communication competency** is presented for each of the augMENTOR pilots.

8 Resources for the Teaching and Assessment of the 4Cs

In support of our pilot partners, the WP4 group has created several resources outlining strategies supporting both the teaching and assessment of the 4Cs. These resources came about because our pilot participants, both on the learner and educator side, had differentiated levels of understanding and experience working in an inquiry-based learning environment. Given the different focuses and learning environments of each of the pilots, as well as the specialised challenges that come with teaching and assessing transversal competencies, it was decided that the WP4 group should develop a body of reference materials to scaffold their efforts.

To address the challenges of incorporating creative pedagogical approaches, a series of one-sheets were created offering practical tips for integrating higher-order thinking and transversal activities into the learning activities. These one-sheets also included strategies for assessing the 4Cs and the effective use of the designed rubrics. When appropriate, additional resources were created to support these strategies including the creation of additional rubrics to facilitate the use of learner self-assessments in class activities. Additionally, the WP4 group sent out open invitations to the pilot coordinators and participating educators to join us during our monthly group meetings to answer any outstanding questions and provide additional context around the 4C rubrics. These invites eventually led to a November workshop entitled, "Assessing the 4Cs", where the WP4 group was able to address and clarify a number of partner questions around their implementation of the pilot rubrics. Figure 2 features examples of the aforementioned one-sheets with the complete set of flyers available in the project's website[3]. It is our hope that these additional resources and scaffolding activities will best position the pilot programs for a fair estimation of the augMENTOR solution and, in particular, the 4C rubrics.

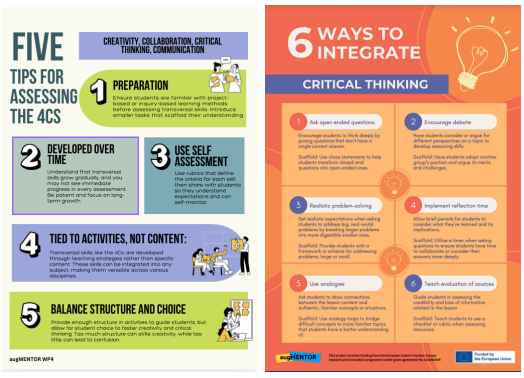

Figure 2. *Showing examples of the resources created to support the pilot programs*

[3] https://augmentor-project.eu/wp-content/uploads/2024/12/Tips-for-Assessing-the-4Cs.pdf

9 Prospective

Following the identification of the 4Cs (D4.1) and the definition of the 4Cs' components (D4.3), the pilots are now prepared to proceed with data collection of the 4Cs. A shared and centralised repository for the 4Cs-related data has been established in the augMENTOR repository to ensure data collection consistency across pilots and enable the analysis of the pilots' 4Cs data in relation to the project's objectives. The adoption of rubrics as the agreed-upon methodology permits having a common assessment strategy for the 4Cs—Critical Thinking, Communication, Collaboration, and Creativity. With three components defined for each competency, rubrics provide a common approach that has been tailored to the contextual needs of the pilots through the specification of the indicators for each rubric adapted for each pilot.

The data collected during the pilots will be analysed to assess the effectiveness of the augMENTOR framework in supporting the development of transversal competencies. The 4Cs data analysis will permit the development of a research paper including the results of the 4Cs assessment that will be led by WP4 in collaboration with the pilots (WP6).

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Annex 1 - Pilots' rubrics

IASIS rubrics

IASIS - Module 1 - Communication Skills - Rubrics

	0.25	0.5	0.75	1.0
Communication Skills	No communication skills for better collaboration with service users.	No communication skills for better collaboration with service users.	Good communication skills for better collaboration with service users.	Excellent communication skills for better collaboration with service users.
Use of Effective Media	Zero ability to use multiple media in order to enrich educational interventions.	Limited ability to use multiple media in order to enrich educational interventions.	Good ability to use multiple media in order to enrich educational interventions.	Excellent ability to use multiple media in order to enrich educational interventions.
Communication Approaches	Zero ability to approach the service user with verbal or non-verbal approaches.	Limited ability to approach the service user with verbal or non-verbal approaches.	Good ability to approach the service user with verbal or non-verbal approaches.	Excellent ability to approach the service user with verbal or non-verbal approaches.
Effective Communication	Lack of communication skills and flexibility in diverse environments with different populations.	Limited communication skills in diverse environments with different populations.	Good communication skills in diverse environments with different populations.	Excellent communication skills in diverse environments with different populations.
Communication Barriers	Zero ability to perceive communication barriers that may hinder communication with the service user.	Limited ability to perceive communication barriers that may hinder communication with the service user.	Good ability to perceive communication barriers that may hinder communication with the service user.	Excellent ability to perceive communication barriers that may hinder communication with the service user.
Understanding of the	Zero understanding	Limited	Good	Excellent

Theoretical Framework	of the theoretical framework of the topic 'communication skills'.	understanding of the theoretical framework of the topic 'communication skills.	understanding of the theoretical framework of the topic 'communication skills.	understanding of the theoretical framework of the topic 'communication skills'.
Collaborative Skills I: Understanding the objective of this training and the ability to apply it in their daily work.	The trainee does not understand the objectives of this training at all and how to apply tools in their daily work.	The trainee has a limited understanding of the objectives of this training and how to apply tools in their daily work.	The trainee has a good understanding of the objectives of this training and how to apply tools in their daily work.	The trainee has an excellent understanding of the objectives of this training and how to apply tools in their daily work.
Collaboration Skills II: Organisational skills within the team	Zero organizational skills within the team.	Limited organizational skills within the team.	Good organizational skills within the team.	Excellent organizational skills within the team.
Collaborative Skills III: Making appropriate decisions	Zero ability to make appropriate decisions and take action in collaboration with the team.	Limited ability to make appropriate decisions and take action in collaboration with the team.	Good ability to make appropriate decisions and take action in collaboration with the team.	Excellent ability to make appropriate decisions and take action in collaboration with the team.
Critical Thinking I: Exploring different perspectives	Zero ability to explore different perspectives or approaches within the workplace context.	Limited ability to explore different perspectives or approaches within the workplace context.	Good ability to explore different perspectives or approaches within the workplace context.	Excellent ability to explore different perspectives or approaches within the workplace context.
Critical Thinking II: Development of Critical Thinking	Zero critical thinking, as reflected in the answers to the exercises.	Limited critical thinking, as reflected in the answers to the exercises.	Good critical thinking, as reflected in the answers to the exercises.	Excellent critical thinking, as reflected in the answers to the exercises.
Creativity I: Creative Thinking	Zero integration/application of creative ideas	Limited application/integration of creative ideas	Good application/integration of creative ideas	Excellent application/integration of creative ideas

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	as they arise from the intervention.	as they arise from the intervention.	as they arise from the intervention.	as they arise from the intervention.
Creative II: Innovation	Zero application of innovative ideas and tools within the work, as they arise from the intervention.	Limited application of innovative ideas and tools within the work, as they arise from the intervention.	Good application of innovative ideas and tools within the work, as they arise from the intervention.	Excellent application of innovative ideas and tools within the work, as they arise from the intervention.

IASIS - Module 2 - Time Management Skills - Rubrics

	0.25	0.5	0.75	1.0
Critical Thinking I: Understanding the elements of the exercise	Zero ability to understand the various elements of the exercise.	Limited ability to understand the various elements of the exercise.	Good ability to understand the various elements of the exercise.	Excellent ability to understand the various elements of the exercise.
Critical Thinking II: Exploring different perspectives	Lack of ability to explore different perspectives of time management related to the exercise.	Limited ability to explore different perspectives of time management related to the exercise.	Good ability to explore different perspectives of time management related to the exercise.	Excellent ability to explore different perspectives of time management related to the exercise.
Critical Thinking III: Forming a critical opinion	Lack of ability to form a critical opinion/view and difficulty in understanding what needs to be integrated/added in an intervention.	Limited ability to form a critical opinion/view and less difficulty in understanding what needs to be integrated/added in an intervention.	Good ability to form a critical opinion/view and good management of what needs to be integrated/added in an intervention.	Excellent ability to form a critical opinion/view and excellent management of what needs to be integrated/added in an intervention.
Understanding of the theoretical framework	Incomplete/Zero understanding of the theoretical framework of the	Limited understanding of the theoretical framework of the topic 'time	Good understanding of the theoretical framework of the topic 'time	Excellent understanding of the theoretical framework of the

	topic 'time management'.	management'.	management'.	topic 'time management'.
Prioritisation	Incomplete/Non-understanding of basic prioritization according to important-urgent-not important-not urgent.	Limited understanding of basic important-urgent-non-important-non-urgent prioritization.	Good understanding of basic prioritization according to important-urgent-not important-not urgent.	Excellent understanding of basic prioritization by important-urgent-not important-not urgent.
Communication I: Communication skills	Lack of communication skills for better and more efficient cooperation with the served.	Limited communication skills for better and more effective collaboration with clients	Good communication skills for better and more effective collaboration with clients	Excellent communication skills for better and more effective collaboration with clients.
Communication II: Using effective media	Insufficient ability to use multiple media to enrich educational interventions.	Limited ability to use multiple media in order to enrich educational interventions.	Good ability to use multiple media to enrich educational interventions.	Excellent ability to use multiple media to enrich educational interventions.
Collaboration Skills I: Understanding the objectives of this training and the ability to apply it in daily work	The trainee does not fully understand the objectives of this training and how he can apply tools in his daily work.	The trainee has limited understanding of the objectives of this training and how he can apply tools in his daily work.	The trainee has a good understanding of the objectives of this training and how he can apply tools in his daily work.	The trainee understands extremely well the objectives of this training and how he can apply tools in his daily work.
Collaboration Skills II: Organisational skills within the team	Low to minimal organizational skills within the team.	Limited organizational skills within the team.	Good organizational skills within the team.	Excellent organizational skills within the team.
Collaboration Skills III: Making the right decision	Minimal to very limited ability to make appropriate decisions and take action.	Limited ability to make appropriate decisions and take action.	Good ability to make appropriate decisions and take action.	Excellent ability to make appropriate decisions and take action.
Creativity I: Creative thinking	Minimal or no application/integratio	Limited application/integratio	Good application/integrati	Excellent application/integrati

	n of creative ideas from the intervention.	n of creative ideas from the intervention.	on of creative ideas from the intervention.	on of creative ideas from the intervention.
Creativity II: Innovation	Incomplete/Zero application of innovative ideas and tools within the work, as they arise from the intervention.	Limited application of innovative ideas and tools within the work, as they arise from the intervention.	Good application of innovative ideas and tools within the work, as they arise from the intervention.	Excellent application of innovative ideas and tools within the work, as they arise from the intervention.

IASIS - Module 3 - Diversity & Social Inclusion - Rubrics

	0.25	0.5	0.75	1.0
Creativity I: Innovation in responses	Zero application of innovative ideas and tools within the work, as they arise from the intervention	Limited application of innovative ideas and tools within the work, as they arise from the intervention	Good application of innovative ideas and tools within the work, as they arise from the intervention	Excellent application of innovative ideas and tools within the work, as they arise from the intervention
Creativity II: Effectiveness and practicality in responses	Zero ability to develop an effective intervention using the elements developed from the program	Limited ability to develop an effective intervention using the elements developed from the program	Good ability to develop an effective intervention using the elements developed from the program	Excellent ability to develop an effective intervention using the elements developed from the program
Creativity III: Integration/implementation skills arising from the responses	Zero ability to integrate tools and apply the theoretical and practical aspects of the program into their daily activities	Limited ability to integrate tools and apply the theoretical and practical aspects of the program into their daily activities	Good ability to integrate tools and apply the theoretical and practical aspects of the program into their daily activities	Excellent ability to integrate tools and apply the theoretical and practical aspects of the program into their daily activities
Understanding of the theoretical framework	Zero understanding of the theoretical framework of the topic	Limited understanding of the theoretical framework of the topic	Good understanding of the theoretical framework of the topic	Excellent understanding of the theoretical framework of the topic

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Inclusion	'diversity-inclusion	'diversity-inclusion'	'diversity-inclusion'	'diversity-inclusion
	Insufficient understanding and application of inclusive ideas/tools within the work environment	Limited understanding and application of inclusive ideas/tools within the work environment	Good understanding and application of inclusive ideas/tools within the work environment	Excellent understanding and application of inclusive ideas/tools within the work environment
Social inclusion	Insufficient way of promoting the social inclusion of service users within the community	Limited way of promoting the social inclusion of service users within the community	Good way of promoting the social inclusion of service users within the community	Excellent way of promoting the social inclusion of service users within the community
Communication skills: Team collaboration	Inadequate communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Limited communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Good communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Excellent communication skills for better and more effective collaboration with service users from different social-disadvantaged groups
Communication skills: Team collaboration	Inadequate communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Limited communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Good communication skills for better and more effective collaboration with service users from different social-disadvantaged groups	Excellent communication skills for better and more effective collaboration with service users from different social-disadvantaged groups
Communication Skills II: Managing Reactions	Insufficient/zero ability to communicate and manage reactions within the team	Limited ability to communicate and manage reactions within the team	Good ability to communicate and manage reactions within the team	Excellent ability to communicate and manage reactions within the team
Collaboration Skills I: Understanding the goals of the current training and the ability to apply them in their	The trainee does not understand the goals of the current training at all and how to apply	The trainee has limited understanding of the goals of the current training and how to	The trainee has a good understanding of the goals of the current training and how to	The trainee has an excellent understanding of the goals of the current

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daily work	tools in their daily work	apply tools in their daily work	apply tools in their daily work	training and how to apply tools in their daily work
Collaboration Skills II: Making appropriate decisions	Zero to minimal ability to make appropriate decisions and take action in collaboration with the team	Limited ability to make appropriate decisions and take action in collaboration with the team	Good ability to make appropriate decisions and take action in collaboration with the team***0.7 points***	Excellent ability to make appropriate decisions and take action in collaboration with the team
Critical Thinking I: Exploring different perspectives	Insufficient ability to explore different perspectives or approaches within the work environment	Limited ability to explore different perspectives or approaches within the work environment	Good ability to explore different perspectives or approaches within the work environment	Excellent ability to explore different perspectives or approaches within the work environment
Critical Thinking II: Development of Critical Thinking	Insufficient critical thinking, as reflected in the answers to the exercises	Limited critical thinking, as reflected in the answers to the exercises	Good critical thinking, as reflected in the answers to the exercises	Excellent critical thinking, as reflected in the answers to the exercises ***1 points***

IASIS - Module 4 - Problem Solving - Rubrics

	0.25	0.5	0.75	1.0
Creativity I: Innovation in responses	Zero application of innovative ideas and tools in the problem-solving process	Limited application of innovative ideas and tools in the problem-solving process	Good application of innovative ideas and tools in the problem-solving process	Excellent application of innovative ideas and tools in the problem-solving process
Effectiveness and Practicality in Interventions	Zero effectiveness of the responses regarding problem-solving	Limited effectiveness of the responses regarding problem-solving	Good effectiveness of the responses regarding problem-solving	Excellent effectiveness of the responses regarding problem-solving

Integration of Theoretical and Practical Tools	Inability to integrate theoretical and practical tools	Limited integration of tools	Good integration of tools	Excellent integration of tools
Understanding of the Theoretical Framework	Zero understanding of the theoretical framework of the unit	Limited understanding of the theoretical framework of the unit	Good understanding of the theoretical framework of the unit	Excellent understanding of the theoretical framework of the unit
Understanding of the Problem-Solving Steps	Zero understanding of the basic steps in problem-solving	Limited understanding of the basic steps in problem-solving	Good understanding of the basic steps in problem-solving	Excellent understanding of the basic steps in problem-solving
Communication Skills I: In Collaboration with a Service User	Inadequate communication skills in collaboration with the service user during the problem-solving process	Limited communication skills in collaboration with the service user during the problem-solving process	Good communication skills in collaboration with the service user during the problem-solving process	Excellent communication skills in collaboration with the service user during the problem-solving process
Communication Skills II: Team Collaboration	Inadequate communication skills in collaboration with a colleague during the problem-solving process	Limited communication skills in collaboration with a colleague during the problem-solving process	Good communication skills in collaboration with a colleague during the problem-solving process	Excellent communication skills in collaboration with a colleague during the problem-solving process
Collaboration Skills I	Inadequate collaboration skills when faced with a problem	Limited collaboration skills when faced with a problem	Good collaboration skills when faced with a problem	Excellent collaboration skills when faced with a problem
Collaboration Skills II: Understanding the objectives of the current training and the	The trainee has no understanding of the objectives of the	The trainee has a limited understanding of the objectives of the	The trainee has a good understanding of the objectives of the	The trainee has an excellent understanding of the

ability to apply them in their daily work	current training and how to apply tools in their daily work.	current training and how to apply tools in their daily work.	current training and how to apply tools in their daily work.	objectives of the current training and how to apply tools in their daily work.1 points
Collaboration Skills III: Making Appropriate Decisions	Zero ability to make appropriate decisions and take action in collaboration with the team	Limited ability to make appropriate decisions and take action in collaboration with the team	Good ability to make appropriate decisions and take action in collaboration with the team	Excellent ability to make appropriate decisions and take action in collaboration with the team
Critical Thinking I: Exploring Different Perspectives	Insufficient ability to explore different perspectives or approaches within the workplace framework	Limited ability to explore different perspectives or approaches within the workplace framework	Good ability to explore different perspectives or approaches within the workplace framework	Excellent ability to explore different perspectives or approaches within the workplace framework
Critical Thinking II: Devel-opment of Critical Thinking	Inadequate critical thinking, as reflected in the exercise answers.	Limited critical thinking, as reflected in the exercise answers.	Good critical thinking, as reflected in the exercise answers.	Excellent critical thinking, as reflected in the exercise answers.

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EASD rubrics

Creativity assessment for EASD pilot - Pilot 3. Programs for Environmental Education in a Network of Eco-schools

Creativity components	Level 1	Level 2	Level 3	Level 4
	0.125	0.25	0.375	0.5
Novelty	Lack of capacity to develop novel ideas for eco-schools	Limited capacity to develop novel ideas for eco-schools	Good capacity to develop novel ideas for eco-schools	Excellent capacity to develop novel ideas for eco-schools
Effectiveness	Lack of capacity to develop an effective strategy for innovating in eco-schools	Limited capacity to develop an effective strategy for innovating in eco-schools	Good capacity to develop an effective strategy for innovating in eco-schools	Excellent capacity to develop an effective strategy for innovating in eco-schools
Implementability	Lack of potential for the implementability of the innovation ideas in eco-schools	Limited potential for the implementability of the innovation ideas in eco-schools	Good potential for the implementability of the innovation ideas in eco-schools	Excellent potential for the implementability of the innovation ideas in eco-schools
Creative problem-solving	Lack of problem-solving skills to analyze, interpret and understand the need for changes	Limited problem-solving skills to analyze, interpret and understand the need for changes	Good problem-solving skills to analyze, interpret and understand the need for changes	Excellent problem-solving skills to analyze, interpret and understand the need for changes
Carbon foot-print	Lack of creativity to suggest original low-carbon solutions (impact and minimization of carbon footprint)	Limited creativity to suggest original low-carbon solutions (impact and minimization of carbon footprint)	Good creativity to suggest original low-carbon solutions (impact and minimization of carbon footprint)	Excellent creativity to suggest original low-carbon solutions (impact and minimization of carbon footprint)
Risk-taking	Lack of creative risk-taking although some solutions cannot be realized immediately with modern technologies	Limited creative risk-taking although some solutions cannot be realized immediately with modern technologies	Good creative risk-taking although some solutions cannot be realized immediately with modern technologies	Excellent creative risk-taking although some solutions cannot be realized immediately with modern technologies

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Critical thinking assessment for EASD pilot

Critical thinking components	Level 1	Level 2	Level 3	Level 4
	0.25	0.5	0.75	1
Grasping the components of an idea	Lack of capacity to grasp the different components of problem-solving skills	Limited capacity to grasp the different components of problem-solving skills	Good capacity to grasp the different components of problem-solving skills	Excellent capacity to grasp the different components of problem-solving skills
Exploring different perspectives	Lack of capacity to explore different perspectives of problem-solving skills	Limited capacity to explore different perspectives of problem-solving skills	Good capacity to explore different perspectives of problem-solving skills	Excellent capacity to explore different perspectives of problem-solving skills
Developing a critical opinion	Lack of capacity to develop a critical opinion of problem-solving skills	Limited capacity to develop a critical opinion of problem-solving skills	Good Capacity to develop a critical opinion of problem-solving skills	Excellent capacity to develop a critical opinion of problem-solving skills

Collaboration assessment for EASD pilot

Collaboration components	Level 1	Level 2	Level 3	Level 4
	0.25	0.5	0.75	1
Sharing understanding and objectives	Lack of capacity to establish and maintain shared understanding and objectives related to an environmental education program	Limited capacity to establish and maintain shared understanding and objectives related to environmental education program	Good capacity to establish and maintain shared understanding and objectives related to environmental education program	Excellent capacity to establish and maintain shared understanding and objectives related to environmental education program
Taking appropriate action	Lack of capacity to take appropriate action to solve the problem related to an	Limited capacity to take appropriate action to solve the problem related to an	Good capacity to take appropriate action to solve the problem related to an	Excellent capacity to take appropriate action to solve the problem related to an

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	environmental education program	environmental education program	environmental education program	environmental education program
Team organization	Lack of capacity to establish and maintain related to an environmental education program	Limited capacity to establish and maintain related to an environmental education program	Good capacity to establish and maintain related to an environmental education program	Excellent capacity to establish and maintain related to an environmental education program

Communication assessment for EASD pilot

Collaboration components	Level 1	Level 2	Level 3	Level 4
	0.25	0.5	0.75	1
Using communication for a range of purposes	Lack of use of communication for supporting an environmental education program	Limited use of communication for supporting an environmental education program	Good use of communication for supporting an environmental education program	Excellent use of communication for supporting an environmental education program
Utilising multiple media according to their effectiveness	Lack of capacity to utilize multiple media according to the effectiveness related to an environmental education program	Limited capacity to utilize multiple media according to the effectiveness related to an environmental education program	Good capacity to utilize multiple media according to the effectiveness related to an environmental education program	Excellent capacity to utilize multiple media according to the effectiveness related to an environmental education program
Communicating effectively in diverse environments	Lack of capacity to communicate effectively in diverse environments for the purposes of an environmental education program	Limited capacity to communicate effectively in diverse environments for the purposes of an environmental education program	Good capacity to communicate effectively in diverse environments for the purposes of an environmental education program	Excellent capacity to communicate effectively in diverse environments for the purposes of an environmental education program

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KTU rubrics

KTU evaluates creativity and critical thinking.

Collaboration and communication is not assessed by KTU pilot.

Creativity assessment for KTU pilot

CREATIVITY COMPONENTS	Level 0 (Novice) 0 points	Level 1 (Beginner) 0.25 points	Level 2 (Intermediate) 0.5 points	Level 3 (Advanced) 0.75 points	Level 4 (Expert) 1 points
Thinking creatively in challenging scenarios in the context of cybersecurity	Makes basic edits or observations without deeper exploration.	Completes required tasks but makes few additional attempts at creativity.	Explores additional possibilities and demonstrates curiosity.	Proposes innovative changes or insights beyond the task requirements.	Demonstrates advanced creativity, proposing novel and impactful solutions.
Developing novel solutions to problems in the context of cybersecurity	Follows instructions with little evidence of problem-solving.	Attempts simple improvements or solutions, with limited depth.	Provides meaningful solutions that show an understanding of the task.	Develops innovative solutions that enhance the task outcome significantly.	Crafts original and sophisticated solutions addressing broader issues or trends.

Critical thinking assessment for KTU pilot

CRITICAL THINKING COMPONENTS	Level 0 (Novice) 0 points	Level 1 (Beginner) 0.25 points	Level 2 (Intermediate) 0.5 points	Level 3 (Advanced) 0.75 points	Level 4 (Expert) 1 points
Making informed decisions based on evidence in the context of cybersecurity	Makes changes or decisions without clear justification.	Explains decisions with surface-level reasoning.	Justifies decisions using task-related evidence and analysis.	Supports decisions with strong reasoning and links to broader cybersecurity concepts.	Integrates multiple evidence sources to make well-informed, strategic decisions.

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Evaluating the implications of decisions in the context of cybersecurity	Identifies risks or consequences minimally or superficially.	Mentions basic implications of decisions with limited analysis.	Provides a detailed analysis of decisions' implications in the task's context.	Analyzes broader implications, considering risks, trends, and organizational impact.	Explores long-term implications, linking to advanced solutions and cybersecurity strategy.
Developing a critical opinion about a problem in the context of cybersecurity	Offers limited or shallow opinions without analysis.	Provides basic opinions but lacks depth or a balanced perspective.	Forms well-reasoned opinions supported by examples or evidence.	Develops thoughtful, nuanced opinions linked to real-world cybersecurity challenges.	Demonstrates expert-level reasoning, presenting forward-thinking opinions based on comprehensive evidence.

Communication assessment for KTU pilot

COMMUNICATION COMPONENTS	Level 0 (Novice) 0 points	Level 1 (Beginner) 0.25 points	Level 2 (Intermediate) 0.5 points	Level 3 (Advanced) 0.75 points	Level 4 (Expert) 1 points
Articulating ideas clearly in the context of cybersecurity	Reflections or explanations are unclear or incomplete.	Communicates basic ideas with minor clarity issues.	Explains ideas clearly with well-structured reflections or responses.	Communicates insights clearly and concisely, with strong organization and language.	Articulates ideas with exceptional clarity, making connections to advanced cybersecurity trends and real-world implications.

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UPATRAS rubrics

In this case, the rubrics have been adapted to align with the content of the activities, and therefore, the descriptions of the activities are also provided in this section for clarity and reference. It is important to clarify that, during the Patras pilot implementation, students were evaluated on these specific skills multiple times to ensure a comprehensive assessment. The examples presented in this section are provided solely for illustrative purposes and do not represent the full scope of activities or assessments conducted.

Ethical use of artificial intelligence- Critical Thinking

Activity 3. Instructions for Using ChatGPT in the Ethics of Artificial Intelligence Assignment

Each student will utilize the ChatGPT tool, using the four (4) questions provided below as core axes. Students will craft relevant prompts (e.g., *"Ethics in the Use of Artificial Intelligence: Suggest a basic structure with four sections*") and refine these prompts based on the responses received. They may modify existing prompts or create new ones as needed to achieve the desired results.

Task Guidelines:

Read, execute, and expand upon the following four (4) questions to create a text deliverable on *Ethics in the Use of Artificial Intelligence*. Answers should be concise, limited to two paragraphs per question.

Questions:

1. Introduction to Artificial Intelligence and Ethics:
    - Define artificial intelligence.
    - Provide a brief overview of the significance of ethics in AI applications.
2. The Need for Transparency and Fairness:
    - Highlight the importance of transparency in algorithms and decision-making processes.
    - Discuss expectations for fair and impartial AI operation.
3. Protection of Confidentiality and Privacy:
    - Explain the importance of data protection and privacy in AI applications.
    - Propose measures to ensure individual privacy.
4. Responsibility in Decision-Making:

- Emphasize the need for responsibility in the development and use of decision-making algorithms.
- Address the risks of automation and the necessity for human oversight.

Research and Preparation:

Students should consult resources such as:

- Materials from the 2nd workshop.
- Internet searches using relevant keywords.

Students will use ChatGPT to generate information related to their assigned module. During this process, they should critically evaluate ChatGPT's responses, refine their prompts for greater focus, and incorporate their own perspectives into the final text. ChatGPT can also assist in summarizing extended texts or bulleted points into cohesive paragraphs.

Purpose of the Exercise:

This activity promotes a comprehensive understanding of the topic by exposing students to diverse viewpoints and encouraging them to engage critically with the material. It also emphasizes skills vital for academic and professional success, such as critical thinking, synthesis of information, and clear communication.

Advantages:

- Encourages exploration of multiple perspectives for a balanced understanding of complex topics.
- Enhances critical thinking and argumentation skills.
- Develops communication and presentation abilities.

Potential Challenges:

- Risk of over-reliance on ChatGPT-generated arguments, potentially undermining personal analytical development.
- Quality of analysis depends heavily on the depth and precision of the prompts provided to ChatGPT.

This approach ensures students develop essential skills while leveraging AI as a tool for learning and exploration

		Grasping the components of an idea	Exploring different perspectives	Developing a critical opinion
Grading criteria				
Question 1	They have included the wrong information/ They have not responded at all 0 points	They use the information from ChatGPT without processing 1.25 points	They combine information from ChatGPT to answer the query 2 points	They transform the information from ChatGPT and produce a critical opinion 2.5 points
Question 2	They have included the wrong information/ They have not responded at all 0 points	They use the information from ChatGPT without processing 1.25 points	They combine information from ChatGPT to answer the query 2 points	They transform the information from ChatGPT and produce a critical opinion 2.5 points
Question 3	They have included the wrong information/ They have not responded at all 0 points	They use the information from ChatGPT without processing 1.25 points	They combine information from ChatGPT to answer the query 2 points	They transform the information from ChatGPT and produce a critical opinion 2.5 points
Question 4	They have included the wrong information/ They have not responded at all 0 points	They use the information from ChatGPT without processing 1.25 points	They combine information from ChatGPT to answer the query 2 points	They transform the information from ChatGPT and produce a critical opinion 2.5 points

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Self reported - assessment rubric for collaboration

Criteria	Level 1 (0 Points)	Level 2 (2 Points)	Level 3 (3 Points)	Level 4 (3.33 Points)
Sharing Understanding and Objectives	No clear understanding of the objectives is demonstrated, and there is no alignment with the activity goals.	A basic understanding of objectives is demonstrated but lacks full alignment with the activity goals.	A good understanding of objectives is demonstrated, and they are mostly aligned with the activity goals.	A thorough understanding of objectives is demonstrated, and all activity goals are fully aligned and integrated into the work.
Taking Appropriate Action	No action is taken to complete the task or produce deliverables.	Minimal action is taken, resulting in incomplete or subpar deliverables.	Action is taken to complete the task, with some minor issues in execution or quality of deliverables.	Effective and appropriate actions are taken to complete the task, producing high-quality and well-executed deliverables.
Team Organization	The team is disorganized, with unclear roles and responsibilities.	Basic organization is evident, but roles and responsibilities are not fully defined or followed.	The team is organized, with roles and responsibilities mostly followed, though some inefficiencies are present.	The team is highly organized, with clearly defined roles and responsibilities that are effectively followed, ensuring smooth collaboration.

Rubric for Assessing Creativity

Activity 7 Annotating activity with creativity development software-

Review the supplementary material from the 7th Workshop, focusing on the following sections:

- Example activity using Tux Paint
- Tux Paint software user guide

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Examine the Preschool Curriculum, specifically Section D: *Subject Area – Child and Arts*.

Provide a commentary on the activity example (limit to 500 words) by addressing the following points:

- Regarding the software:
  - Identify the software tools and commands emphasized in the activity.
- Regarding the Study Program:
  - Specify the Thematic Unit and Thematic Subunit the activity corresponds to.
  - Outline the expected individual learning outcomes of the activity.
  - Share your overall opinion on the activity, or suggest an alternative activity idea.
  - Conclude by commenting on another participant's post

Rubric for Assessing Creativity -use Drawing Software

Novelty - Description of use of Software tools	They have not described the software tools and commands used in the activity 0 points	They have described only the tools or only the software commands used in the activity 1.66 points	They have described software tools and commands that are used in the activity with deficiencies or errors 2.66 points	They have described software tools and commands that are used in the activity fully and with proper justification 3.33 points
Effectiveness- Link to the Curriculum	They have not made the connection of the activity with the Curriculum 0 points	They have made the connection to the Curriculum -Subject Areas - Units and Subunits but have not recorded expected learning outcomes 1.66 points	They have made the connection to the Curriculum-Subject Areas - Modules and Submodules have recorded expected learning outcomes but with deficiencies or errors 2.66 points	They have made the connection to the Subject Areas - Modules and Submodules have recorded expected learning outcomes without errors and with appropriate justification 3.33 points
Implementability - Proposal for utilization of the Software	They have not commented on another post and have not suggested	They have commented on another post but almost verbatim and	They have commented on another post using arguments related	They have commented on another post using arguments related

	a new idea for using the software 0 points	without proper arguments (eg "I agree"). They have commented on the activity without suggesting a new idea 1.66 points	to the software or the use of the Software, they have commented on the activity and they propose an innovative idea that is not very different from the activity they studied 2.66 points	to Curriculum and the use of the Software, they have commented on the activity and suggest an innovative idea that uses arguments from the course material but is very different from the example they studied 3.33 points

Activity 8: Concept Mapping - Developing Creativity

Purpose of the Work

The goal of this work is to understand the fundamental principles of conceptual mapping as a constructive learning method. It also focuses on the integration and practical use of conceptual mapping software in the educational process, emphasizing its potential to help achieve specific teaching goals.

Subject of the Work

As a preschool teacher, your role is to design a teaching intervention using conceptual mapping software. Educational software, as discussed, acts as a technological aid in teaching and learning. For this activity, you will address a real-world problem using *Kidspiration* concept mapping software as an instructional tool.

You are required to organize a conceptual map for environmental study by selecting one of the suggested thematic units below. The map will later serve as a foundation for a teaching intervention.

Individual Activities

1. Familiarize yourself with the basic features of the educational software.
2. Select a thematic unit to create your conceptual map from the following options:
   a. *Seasons*

b. *Occupations*
c. *Recycling*
d. *Traffic Education*
e. *Children of the World*
f. *My Neighborhood*

3. Create a conceptual map to be used as a learning tool by choosing one of these techniques (examples provided in the supplementary material):
   a. Filling out a map
   b. Fixing a map
4. **Activity Description:**
   Write a detailed description (300–500 words) of the educational activity in which the conceptual map will be used. Address the following points:
   - Thematic module of the activity
   - Thematic Area and Thematic Activity Unit
   - Expected Learning Outcomes
   - Use of concept mapping (refer to Lab 8 material)
   - Method of integrating the map into teaching
   - Added value of the software in the activity (refer to Lab 8 material)

Implementation and Submission Instructions

1. Create the Work File: Use a text document editor on your computer or work online.
2. Rename the File: Use the following format: Ergasia_8ou_Ergasthriou_onoma_am.
3. Create the Concept Map: Use *Kidspiration* software provided in the workshop material: Kidspiration Link.
4. Save Your Map: Save the conceptual map as an image and insert it into your work file.
5. Complete the Questions: Answer all individual activity questions in the work file.
6. Submit Your Work: Upload the final file to the Moodle platform.

Grading criteria **Novelty**	They have not created a concept map. 0 points	They have created a concept map but have not included connections or have not fully developed the concept 1.66 points	They have created a concept map but the connections they have included are only at the first level 2.66 points	They have created a concept map, included appropriate connections, and fully developed the concept 3.33 points
Effectiveness- Link to the Curriculum	They have not created a conceptual map and do not mention its subject matter 0 points	They have created a concept map but the content does not match the theme or they have not fully developed the concept 1.66 points	They have created a concept map but have not effectively made the connection to the Curriculum 2.66 points	They have created a concept map and have effectively made the connection to the Curriculum 3.33 points
Implementability	They have not created a conceptual map and have not described the teaching activity that will include it 0 points	The conceptual map that they have designed does not correspond to any of the three options according to the job description and they have not mentioned the capabilities that they use 1.66 points	The concept map that they have drawn corresponds to none of the three options according to the job description and they have mentioned some of the capabilities that they use 2.66 points	The conceptual map that they have drawn corresponds to all of the three options according to the job description, they have mentioned the capabilities that they use and they have fully described the activity that will use it 3.33 points

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