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FUTURES LITERACY OF QUALITY AND ITS RELATIONSHIP TO SUSTAINABLE DEVELOPMENT AND MANAGEMENT

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Abstract: Futures literacy is a concept that is gaining importance in today's dynamically changing world. It is the ability to use the future as a tool to make informed decisions and implement innovations now. According to UNESCO and the European Union, futures literacy is one of the key competences that allows us to be better prepared for different future scenarios. Through this skill, we can better understand and predict changes, which is extremely important in the context of global challenges such as technological development, and climate and social change.

Futures literacy of quality combines the concept of futures literacy with the pursuit of improving quality in various areas of life (from education to industry), and enables a better understanding of future trends and challenges regarding the quality of products, services and processes.

Moreover, nowadays traditional approaches to literacy may prove insufficient in preparing individuals for the complexity and uncertainty of tomorrow. Integrating the principles of sustainable development and quality management in education requires a future-oriented view of literacy. There is therefore a need for a comprehensive understanding of the interdependencies between futures literacy, quality and sustainable development.

Examples of the application of futures literacy in the context of improving sustainability and quality management are presented.

Keywords: futures literacy, quality, sustainability, education, sustainable development, management.

1. THE HISTORY OF PREDICTING THE FUTURE

The history of predicting the future has come a long way from ancient fairies and oracles [Halpern 2004; Tony 2004], to the modern concept of futures literacy. A brief overview of this evolution covers five periods. In ancient times, people often turned to oracles, fairies and shamans to gain insights into the future. An example is the

Delphic Oracle in ancient Greece, where priestesses (Pythias) predicted the future based on visions and interpretations of signs. Mention should be made of the Roman augur oracles, the Mayan prophecies, the Aztec calendar, and the prophecies of Nostradamus, among others. For a history of foretelling and predicting the future, see Halpern's anthology [Halpern 2004]. The most famous visionaries and prophets are described by Tony [Tony 2004].

In the Middle Ages, astrology and alchemy were popular methods of predicting the future. Astrologers analysed the movements of the planets and stars to predict events, while alchemists searched for the philosopher's stone and the elixir of life. The alchemy treatise entitled 'On the Philosopher's Stone [Bugaj 1971], in Latin '*De lapide philosophorum tractatus duodecim e naturae fonte et manuali experientia depromti*', was published in 1604 by the Polish alchemist Michał Sędziwój [Bugaj 1968].

During the Renaissance, more emphasis began to be placed on scientific research methods. Predicting the future began to be based on observations and experiments, which led to the development of the natural sciences. The scientific prediction of the future was vividly presented by Tadeusiewicz in his opinion piece [Tadeusiewicz 2021].

In the nineteenth and twentieth centuries, developments in statistics, mathematics and technology made it possible to forecast the future more accurately. Mathematical models and data analysis became the basis for predicting economic, social and technological trends using, among other things, the principles of thermodynamics [Czaja 1997; Jakimowicz 2020]. Since the 1970s, futurology, a discipline of knowledge concerned with predicting and forecasting the future, has been developing [Bönish 1980]. Among others, Stanislaw Lem [Lem 2003] was a futurologist.

Special institutes have been set up to predict the future, an example of which is the Institute For The Future (ITF), which has been successfully operating in Palo Alto for more than 55 years [Institute For The Future, 2025]. The IFTF conducts futures studies aimed at forecasting the likely pattern of economic, social and scientific events. In Poland, futures studies are conducted, among others, by the Polish Association of Futures Studies [PTSP]. *Among the many papers of this Society, consideration of why the future cannot be predicted* (Kołos, 2014) *draws attention. There is a Forecasting Committee (pol. Komitet Prognoz PAN) at the Polish Academy of Sciences. In September 2024, the 4th Futurological Congress, organised by the Polish Science Fiction Foundation, took place in Cracow, bringing together prominent representatives of the world of literature, science and technology. As can be seen, the problem of predicting the future is a broad subject of interest.*

The evolution outlined shows how our approach to the future has evolved with the development of knowledge and technology. The most recent contemporary trend is the aforementioned futures literacy. Currently, futures literacy is the ability to understand, anticipate and prepare for future challenges. It includes both scientific

foresight and the development of critical thinking and adaptation skills. Futures literacy is crucial in education, helping societies to better prepare for climate, technological and social change. In the 21st century, we are witnessing an unprecedented pace of change, driven by technological progress, globalisation, and growing environmental challenges. This dynamic reality forces a reevaluation of traditional concepts of literacy. It is no longer enough to possess basic reading and writing skills. Nowadays, it is necessary to develop competencies that will allow individuals to navigate an uncertain future and actively shape it. In this context, the idea of 'Futures literacy' emerges as a concept encompassing the ability to anticipate future trends, adapt to changes, and actively participate in creating desired scenarios.

2. THE IDEA OF FUTURES LITERACY

Traditionally, literacy was defined as the ability to read, write, and perform basic arithmetic, considered a foundation for social participation and individual development. However, in the digital age, this definition has undergone significant expansion. The impact of digital technologies has meant that literacy now also includes digital, information, media, and technological competencies [Eshet-Alkalai and Chajut 2009; Sousa and Wilks 2018; European Commission 2020]. Digital literacy is understood as the ability to use information and communication technologies to search, evaluate, create, and communicate information [Jones-Kavaliar and Flannigan 2006]. In digital environments, critical thinking and social engagement play a key role. Digital literacy combines both technical skills and cognitive abilities. With the advancement of artificial intelligence (AI), the very concept of digital literacy is also evolving. This evolution reflects a shift from focusing on individual cognitive skills to encompassing broader competencies necessary to navigate an increasingly complex and technologically mediated world. This suggests that educational systems and curricula must be adapted to assess and develop these expanded literacy skills [Johnson et al. 2021]. Furthermore, in the 21st century, the concept of multiliteracies, which recognises diverse forms of text and communication beyond traditional written text, is gaining increasing importance. It includes visual, auditory, and other multimodal forms of information.

Different types of literacy (digital, information, media, technological) are interconnected, which indicates the need for a holistic approach to literacy education, rather than teaching them in isolation. Many sources emphasise the dynamic and constantly evolving nature of literacy in response to technological progress, which suggests that educators themselves must be lifelong learners to keep up with these changes and equip students with the appropriate skills [Wiśniewska and Grudowski 2017; Jacobs and Castek 2018; Vanek 2019; UNESCO 2023]. Literacy is no longer seen as a binary state, but as a spectrum of proficiency that develops throughout life. Different types of literacy (digital, media, information, technological) integrate into

a broader understanding of 21st-century skills. The overlap of different types of literacy indicates the interrelationships of these skills, suggesting that a holistic approach to futures literacy of education is more effective than teaching them separately. The emphasis on ‘new literacies’ highlights the dynamic and constantly evolving nature of literacy in response to technological progress.

Futures literacy is the ability to imagine diverse and multiple futures and to use the future as a lens through which we look at the present anew. UNESCO defines futures literacy as the ability to better understand the role of the future in what we see and do [UNESCO 2023]. Being futures literate empowers the imagination and enhances the ability to prepare, recover, and innovate in the face of change. The term alludes to the idea of literacy in reading and writing, as it is a skill that everyone can and should acquire. Futures literacy helps to understand why and how we use the future to prepare, plan, and interact with the complexity and novelty of our societies. It is not just about predicting the future, but about actively shaping it. The European Union also places great emphasis on the literacy of the future, recognising it as a key competence in the development of innovative policies [European Commission 2025].

The broader understanding, both theoretical and operational, assumes that competence is a mix of knowledge, skills, and attitudes as well as metacognition, strategic thinking, while it presupposes conscious and intentional decision-making [Westera 2001].

From that perspective, the key competencies of futures literacy include:

- understanding complexity and uncertainty;
- imagining many possible future opportunities (probable, preferred, reframed);
- being aware of anticipatory assumptions and their sources;
- using the future to rethink the present;
- supporting diverse futures through participatory processes, agency and empowerment to innovate and diversify choices;
- innovativeness and the use of innovation;
- agility and adaptation to change;
- discovering new possibilities and novelty;
- confidence and resilience in the face of risk and uncertainty, making choices and building diverse options;
- strategic thinking and seeing different alternatives;
- leadership strength in developing different initiatives and introducing new solutions;
- rethinking and considering many ways of understanding the various phenomena;
- competence in the conscious use of the future.

The key competencies of futures literacy are presented in Table 1.

Table 1. Key competencies of futures literacy

Competence	Short description
Understanding complexity and uncertainty	Awareness that living systems are complex, unpredictable, and uncontrolled; a posture of humility towards this complexity
Imagining many possible futures	Ability to distinguish different types of futures (probable, preferred, reframed) and their application
Awareness of anticipatory assumptions	Understanding that imaginations and ideas of the future are based on anticipatory assumptions that can be identified and questioned
Using the future to rethink the present	Ability to look at the present from a long-term perspective and see new opportunities for action
Supporting a diverse future	Enabling learning processes that consider different perspectives and ways of knowing
Performance and empowerment	Ability to innovate and diversify choices by considering alternative perspectives
Innovativeness	Facilitates innovation and the use thereof
Agility	Increases the speed at which changes are perceived, and decisions are made
Discovery	Facilitates the detection and understanding of novelty, shocks, and surprises
Confidence	Facilitates changes by making them more understandable
Decision-making capacity	Facilitates the building of more diverse options of choice and making informed choices
Strategic thinking	Facilitates the perception of genuinely different strategic alternatives
Creative thinking	Using imagination to generate innovative ideas and solutions
Resilience	Facilitates approaching risk and uncertainty through diversification
Knowledge (including sustainability)	Encompasses many ways of knowing the world around, including sustainability aspects (environmental, social and economic ones)
Time perspective	Ability to consciously, purposefully and effectively utilise the understanding of the past, present, and future for various reasons and in various ways
Leadership strength	Enables initiative and experimentation for the whole society

Source: own collaboration based on [Damhof et al. 2020; Bergheim 2024].

The significance of futures literacy lies in coping with the uncertainty of the future (climate change, pandemics, economic crises, social exclusion), overcoming ‘poverty of imagination’ and instilling hope, democratising the sources of human imagination about the future, and being a catalyst for innovation, discoveries, leadership, choice, strategy, agility, confidence, capability, knowledge, and resilience [Transformative Innovation Policy Consortium 2021]. It is essential for the effective and efficient use of the future in management and decision-making, crucial for ensuring that global policies are appropriate for local communities, strengthens resilience and the ability to self-renew, and is a catalyst for inter- and trans-disciplinarity [Leicht, Heiss and Byun 2018].

2.1. Theoretical foundations of futures literacy: Anticipatory systems and processes

Futures literacy is not merely a practical skill – it is grounded in the theory of anticipatory systems, which provides an analytical framework for understanding how individuals and organisations engage with the future. According to Rosen [1985], an anticipatory system is one that contains a predictive model of itself and/or its environment, allowing it to change state following predictions about the future. This concept is central to futures literacy, which enables people to use imagined futures to inform present decisions.

Anticipatory processes can be categorised into:

- Passive anticipation – reacting to expected events based on past patterns.
- Active anticipation – shaping actions intentionally based on imagined futures.
- Complex anticipation – navigating uncertainty through multiple, diverse scenarios.

Futures literacy enhances the capacity to engage in complex anticipation. It enables individuals and organisations to recognise early signals of change, interpret trends, and imagine futures that challenge dominant paradigms. This theoretical lens clarifies how futures literacy generates the benefits outlined in this article – such as resilience, innovation, and strategic foresight – and provides the analytical tools necessary to evaluate its impact.

Ontologically, futures literacy assumes that the future is not predetermined but open, shaped by human agency and imagination. Epistemologically, it challenges individuals to reflect on how they construct knowledge about the future, including the assumptions and biases embedded in their anticipatory models. In this context, Karlsen [2021] introduces the notion of ‘ontological and epistemological oxymorons’ to highlight the paradox of attempting to know something that does not yet exist. Ontologically, the future remains a realm of potentiality, inaccessible within the bounds of present reality. Epistemologically, however, we attempt to model and anticipate it as if it were cognitively available. This paradox reveals the limitations of conventional forecasting methods and underscores the need for more reflexive and critical approaches to futures thinking.

Building on this foundation, Skulimowski [2011] introduces the concept of superanticipatory systems – systems capable of generating and evaluating multiple future scenarios based on dynamic criteria. As he notes, ‘superanticipatory systems are capable of modifying their own anticipatory mechanisms in response to evolving environmental signals’. This principle resonates with the adaptive nature of futures-oriented learning and supports the idea that futures literacy is not static but evolves through reflexive engagement with uncertainty.

That ‘anticipation is not merely a forecast but a normative orientation toward possible futures’. This distinction is crucial for understanding futures literacy as a mode of epistemic engagement rather than probabilistic modelling. It highlights that futures literacy involves not only cognitive foresight but also ethical reflection and intentionality.

By embedding this theoretical perspective, futures literacy emerges not only as a practical competence but as a dynamic epistemic and systemic capability. It enables deeper insight into how futures are imagined, contested, and shaped – supporting its integration into education, sustainability strategies, and quality management systems as a transformative tool for navigating uncertainty.

3. PRACTICAL APPLICATIONS OF FUTURES LITERACY

Futures literacy competence refers to the ability and capacity for understanding, utilising, and shaping the future through imagination, planning and adaptation. With this expertise, we can better understand and anticipate change, which is extremely important in the context of global challenges such as climate change, technological developments, and social changes. Futures literacy involves imagining diverse, multiple future possibilities and opportunities, and using these visions as lenses to revise the present. Thus, the limitations of imagination can be overcome, which results in introducing better strategies and policies. The importance of this competence is evident in many sectors, from business and politics to healthcare and sustainability, where making informed decisions with the future in mind is crucial. This is what proves the specific nature of futures literacy, which focuses on anticipating and shaping future possibilities. Futures literacy enables individuals and organisations to effectively analyse trends and early signals of change, which is the foundation of a proactive approach to the future.

The field of science closely related to futures literacy is foresight. It emphasises the analysis of long-term changes (trends) and early signs of potentially significant future transformations (signals). The ability to identify and interpret these trends and signals, supported by futures literacy, allows not only an understanding of the direction of change, but more importantly an assessment of its implications for the present and future. Identifying trends and early signals enables proactive preparation for upcoming changes, helps to avoid overlooking new opportunities and facilitates the identification of potential threats and prospects. Competences such as the ability to find and interpret signals of change become crucial in the context of foresight and preparation for future work. Advanced technologies such as artificial intelligence and machine learning can also be used in this process to help detect early signals and correct errors in pattern recognition. Foresight methodologies, integral to the practical application of futures literacy, often begin by identifying key drivers of change and areas of uncertainty [Final Report of the FORMAKIN Project 2001]. Understanding these fundamental factors is essential for properly interpreting the significance and potential impact of observed trends and signals. Trend analysis involves identifying recurring patterns in the data, understanding their evolution, and comparing forecasts with actual results, often helping to introduce innovations. Trend watching, closely related to trend analysis, also focuses on detecting and interpreting changes occurring in different areas of reality. Futures literacy provides

a perspective through which these patterns and changes are understood in terms of potential future scenarios and their consequences. Creating procedures to intelligently monitor the environment enables timely updating of plans and strategies based on emerging signals. This highlights the dynamic and iterative nature of the practical application of futures literacy, which requires continuous monitoring and adaptation to changing conditions.

Futures literacy significantly facilitates the creation and use of future scenarios, which are a key tool in the anticipation and strategic planning process. Scenario planning is a strategic management tool that helps to anticipate and prepare for various potential future events or occurrences [Miller 2007]. Scenarios are comprehensive and systematic visions of future opportunities and development paths, allowing for a broader perspective on the perception of what lies ahead [Kosow and Gaßner 2008]. Alphabetising the future provides the imagination and critical thinking skills necessary to effectively create and analyse these diverse visions of the future. There are various techniques for creating scenarios, including identifying the drivers of change, assigning values to them and interpreting their behaviour within archetypal images of the future, such as optimistic, pessimistic or most likely scenarios. Futures literacy enables a more creative application of these techniques, going beyond a simple extrapolation of current trends. It encourages exploration of ‘what if’ questions and consideration of disruptive change. Scenario matrices are a key outcome of foresight research, which is closely linked to the practical application of futures literacy [Final Report of the FORMAKIN Project 2001; Kosow and Gaßner 2008]. They provide a structured framework for visualising and comparing different potential futures, facilitating strategic decision-making. Scenario planning helps organisations simulate different futures, assess risks and opportunities and make data-driven decisions, balancing short-term needs with long-term priorities. It enhances adaptability and helps determine a course of action in an uncertain environment.

Examples of the use of scenarios include companies developing new products by imagining different consumer behaviours or preparing for complex global challenges such as climate change and pandemics. These specific examples illustrate the wide range of practical applications of scenario planning, supported by futures literacy [Johnson, et al. 2021]. Educational institutions can also use scenario planning to anticipate future challenges and opportunities in the changing landscape of higher education [Sousa and Wilks 2018; Damhof, et al. 2020].

Creative thinking plays a key role in the literacy of the future, enabling individuals and organisations to imagine and shape their desired futures. Futures literacy enhances the capacity for creativity, openness, experimentation and innovation [UNESCO 2023]. It involves consciously and creatively imagining different possible futures, thus generating innovative ideas and solutions. Creative thinking is not just a marginal skill, but is a fundamental element of futures literacy, enabling the generation of original insights and solutions in the face of uncertainty. Techniques such as brainstorming, lateral thinking, SCAMPER and mind mapping

are essential tools for developing creative thinking in the context of exploring the future. These methodologies provide practical ways to stimulate imagination, which is central to futures literacy. Through the application of these techniques, individuals and groups can generate a wider range of ideas about the future and potential pathways forward. Foresight, which relies heavily on futures literacy, uses expert panels and brainstorming to stimulate new insights and creative, strategic scenarios for the future. Combining expert knowledge with creative thinking can lead to more robust and innovative foresight results.

Creativity involves the generation of new ideas, concepts and connections, often requiring flexibility, risk-taking and the ability to challenge existing assumptions. These qualities of creativity directly align with the goals of futures literacy, which seeks to broaden perspectives and explore unknown areas of opportunity.

Futures literacy encourages the development of these creative attributes, enabling individuals and organisations to respond more flexibly and innovatively to the challenges of the future. Creative thinking enables a more positive and proactive response to the inherent uncertainty of the future, encouraging exploration and adaptation rather than fear of the unknown.

4. CONNECTIONS AND SYNERGIES BETWEEN FUTURES LITERACY AND SUSTAINABILITY

Futures literacy is a tool that supports sustainable development by empowering youth to imagine and build a sustainable future. It increases the ability to anticipate and respond to complex environmental and social challenges, promotes long-term thinking and consideration of the needs of future generations, supports innovation and the development of sustainable solutions, encourages a change in mindset towards sustainable development and responsible action, and supports the achievement of the Sustainable Development Goals (SDGs) [Leicht, Heiss and Byun 2018; UNESCO 2020].

As shown in Figure 1, futures literacy offers several benefits in the context of supporting sustainable development. This is a competence that allows individuals and organisations to better understand the role of the future in their current actions and decisions, which is crucial for achieving the sustainable development goals.

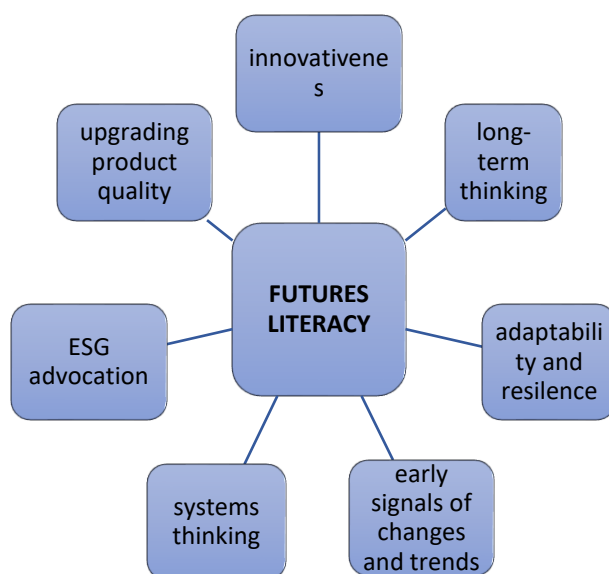


Fig. 1. Benefits of futures literacy in supporting sustainability

Source: own collaboration.

In the following section, a brief description of some specific benefits will be presented.

Futures literacy supports **long-term thinking**. In the face of short-term perspectives dominating many fields, futures literacy teaches how to consider the long-term consequences of today's actions, which is key to the sustainable development that by definition concerns both present and future generations. Futures literacy is not just about imagining a sustainable future, but also about understanding the actions taken in the present that are necessary to achieve it, creating a direct link between future-oriented thinking and sustainable development practices.

Competencies of futures literacy, such as **systems thinking and anticipation**, are crucial for understanding the complex interdependencies between social, economic, and environmental systems, which is essential for effectively solving the multidimensional problems associated with sustainable development.

Moreover, futures literacy fosters **innovation**. By exploring diverse, possible futures, futures literacy stimulates creative thinking and helps in generating novel solutions to sustainable development problems that go beyond traditional patterns. Digital literacy plays a key role in sustainable consumption and development by enabling access to information on environmental issues and sustainable practices, facilitating community engagement in sustainable development initiatives, supporting the implementation of green technologies and sustainable lifestyles and promoting informed decision-making regarding sustainable products and

consumption [Hu and Meng 2023]. It connects digital literacy with environmental literacy. Digital literacy acts as a key enabler of sustainable development by providing access to the information, tools, and networks necessary to promote sustainable consumption and development. Digital technologies can be used to monitor and report progress on sustainable development, increasing transparency and accountability.

The combination of futures literacy and digital literacy creates a powerful synergy, equipping individuals with the ability to imagine desired sustainable futures and to use digital tools to analyse, communicate, and work towards their realisation. This implies that educational strategies should aim to develop both competencies in an integrated manner. Furthermore, quality management in the context of sustainable development requires the use of data and digital technologies to monitor the environmental and social impact of educational products and processes, ensuring continuous improvement towards more sustainable practice [Fernandes and Gabriel 2025].

The next benefit of futures literacy is increased **adaptive capacity and resilience**. Understanding potential future challenges, such as climate change or resource depletion, enables better preparation for them and faster adaptation to changing conditions, which is crucial for long-term sustainability.

Futures literacy helps in recognising **early signals of changes and trends**, which allows for proactive responses to emerging opportunities related to sustainable development and avoiding potential threats resulting from unsustainable practices. By imagining desired, sustainable futures, individuals and communities gain a sense of agency and are more inclined to take actions aimed at realising these visions.

The next benefit is **ESG support**. ESG is an acronym that stands for environmental, social and governance. It refers to a set of standards used to measure an organisation's environmental and social impact. ESG encompasses the data and metrics needed to inform decision-making for companies and investors alike. [Foltynowicz and Kaps 2022]. In this context, futures literacy can help companies anticipate future challenges and regulations in the environmental, social, and governance areas, enabling the proactive implementation of sustainable practices.

Futures literacy can play a key role in increasing **product quality**. It enables companies to predict future consumer expectations regarding the durability, eco-friendliness, and ethical aspects of products, which leads to an improvement in their quality.

The principles of sustainable products [European Commission 2025] can also be applied to education by treating educational programs and resources as 'products' that should be designed and delivered in a sustainable manner. In the case of educational institutions, the focus is on minimising their impact on the environment (resource consumption, waste generation, energy efficiency), promoting sustainable consumer behaviours among students through curriculum and institutional practices, integrating sustainable development topics throughout the curriculum, and using digital technologies to support sustainable development in education (reducing paper

consumption, e-learning, sustainable transportation or waste management) [UNESCO 2017; Chankseliani and McCowan 2021; Grobler 2022].

Sustainability in education also means designing curricula and teaching materials with durability and reusability in mind, minimising the need for frequent updates and replacements. Educational institutions can strive to reduce their ecological footprint by choosing suppliers guided by the principles of sustainable development and by promoting environmental awareness among students and staff.

Apart from the undoubted benefits it brings, futures literacy can add significant added value, as it helps in **questioning assumptions**. Many unsustainable practices are based on unquestioned assumptions about the future. Futures literacy encourages critical reflection on these assumptions and the exploration of alternative perspectives, which paves the way for more sustainable solutions.

Strategies for developing futures literacy include the use of foresight methodologies and tools in educational settings, the facilitation of Futures Literacy Laboratories (FLL), the encouragement of imagination, the questioning of assumptions about the future, and the promotion of strategic conversations and open inquiry.

Strengthening the quality of education through futures literacy and sustainable development requires integrating futures literacy competencies with curriculum frameworks, developing teacher training programs focusing on futures literacy and education for sustainable development, using innovative pedagogical approaches (project-based learning, experiential learning), responsible use of digital tools and artificial intelligence to enhance learning about sustainable development, and implementing quality assurance mechanisms that take into account outcomes in futures literacy and sustainable development.

Ethical challenges related to artificial intelligence in education should also be addressed. Policies promoting future skills and literacy for sustainable development should strengthen the public vocational training system to support the development of future skills, invest in upskilling and reskilling initiatives, integrate awareness of sustainable development with education and training systems, promote skills-based learning and employment, and develop national frameworks for future and sustainable development competencies.

In the context of sustainable product and quality management, strategies should include establishing sustainable development standards for educational institutions, promoting transparency in the supply chains of educational resources, implementing environmental management systems (e.g., in line with ISO 14001 or other relevant standards), and engaging students and the community in sustainable development initiatives.

5. CHALLENGES AND STRATEGIES FOR DEVELOPING SUSTAINABLE FUTURES LITERACY

Futures literacy provides the foundation for sustainability efforts by stimulating the ability to imagine and analyse a wide range of future possibilities. This ability allows one to look beyond current perspectives and understand the long-term consequences of today's decisions on the environment, society and the economy. By considering and exploring a variety of scenarios, including those of climate change, biodiversity loss and natural resource depletion, futures literacy enables a deeper understanding of the complex challenges of sustainability.

A key aspect of futures literacy is the development of anticipatory systems that enhance the ability to identify and respond to early signals of changes and trends, as discussed in the previous section. In the context of sustainability, the ability to recognise subtle signals indicating the emergence of new environmentally friendly technologies, shifts in consumer behaviour towards greener choices, and growing environmental risks is fundamental. This allows proactive actions to be taken that not only support sustainability but also minimise the potential negative consequences of unsustainable practices.

Futures literacy also stimulates critical reflection on our assumptions about the future. Many of the socio-economic paradigms that have contributed to current sustainability challenges are based on unquestioned assumptions about unlimited growth and resource exploitation [Gorynia 2021; Banaszyk et. al. 2023]. By challenging these fundamental beliefs and exploring alternative visions of the future, futures literacy paves the way for innovative and more sustainable solutions. The creative thinking fostered by futures literacy enables the discovery of new perspectives and the search for out-of-the-box solutions to sustainability problems.

Futures literacy contributes to building resilience and adaptive capacity, which are essential in the face of uncertainty and disruption associated with climate change and other critical sustainability challenges. The ability to imagine a variety of future scenarios and understand their potential consequences enables better preparation for unexpected events and faster adaptation to changing conditions, which is key to achieving long-term sustainability.

In a business context, futures literacy plays an important role in introducing ESG (Environmental, Social, and Governance) strategies. Companies that can anticipate future environmental regulations, changing societal expectations and potential governance risks are better equipped to implement proactive ESG strategies. For example, imagining a future in which customers prefer environmentally friendly products can lead companies to invest in sustainable materials and production processes, which not only responds to potential future trends but also strengthens their position in terms of environmental responsibility (E-component). Similarly, anticipating future societal challenges, such as inequality or labour issues, allows for the implementation of strategies that improve relations with employees and local communities (S-component). Finally, the ability to

anticipate changes in regulations and governance standards (G-component) enables companies to adapt their management practices to future requirements, which minimises risk and increases their long-term sustainability.

The links between futures literacy and product quality are becoming increasingly apparent in the context of sustainability. Companies that apply futures literacy are better able to anticipate future consumer needs and expectations regarding product quality in an environmental and social context. By anticipating a future in which natural resources are limited and consumers' environmental awareness increases, companies can design products with higher sustainability, are easier to recycle, and have a lower carbon footprint.

Furthermore, anticipating future ethical and social standards can prompt companies to invest in product quality by ensuring fair working conditions in the supply chain or transparency about the origin of raw materials [Witczak 2020]. In this way, futures literacy not only supports sustainability but also contributes to improving product quality in response to future challenges and market expectations.

Futures literacy finds concrete applications in many areas related to sustainable development. In the context of climate action planning, futures literacy methods such as scenario building enable the exploration of different scenarios of greenhouse gas emissions and their potential impacts. It also allows the visualisation of desirable futures that are resilient to climate change, which in turn informs mitigation and adaptation efforts currently underway.

In the area of biodiversity conservation, futures literacy can be used to model future ecosystems in relation to different conservation strategies, and to assess the long-term consequences of species and habitat loss. By imagining future landscapes and interspecies interactions, more effective and long-term conservation plans can be developed.

In the context of a circular economy, futures literacy plays an important role in creating visions of future production and consumption systems that minimise waste generation and maximise resource reuse and recycling [Foltynowicz 2023]. Imagining alternative business models and supply chains that are more sustainable can stimulate innovation and contribute to more resource efficiency [Witczak 2024].

Futures Literacy Labs and frequently used foresight methods, such as horizon scanning and scenario development, are increasingly being used to promote sustainability-oriented thinking and action in various sectors, including finance, education, policy and community development.

However, it is important to note that the development of futures literacy in the context of supporting sustainable development faces challenges related to access to information. Inequalities in access to technology and the Internet, known as the digital divide, can limit the ability to utilise the educational resources and tools necessary for developing future anticipation skills, particularly in marginalised communities.

Furthermore, information inequality and a lack of critical information evaluation skills online can hinder the effective use of futures literacy for making informed decisions that support sustainable development. Another significant challenge lies in the low level of knowledge about sustainable development across various societal groups.

6. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

The concept of futures literacy is evolving in the 21st century, and futures literacy is becoming a key competence. It plays a significant role in enhancing the quality of education and preparing individuals for an uncertain future. There are strong links between futures literacy, sustainable development, and quality. Futures literacy requires the integration of technology, sustainability and climate education to meet the challenges of today's world. Education must be flexible and adaptable to changing social and economic needs, promoting the skills needed to cope with future challenges. Overcoming the challenges requires integrated strategies and policies at various levels. Further research should focus on the long-term impact of futures literacy in education, especially in the fields of quality and sustainability. The aim should be to introduce innovative approaches in developing and assessing these competencies, and the ethical aspects of integrating future-oriented thinking and technology in education. Taking into account the issues of sustainable products and quality management in education is essential for creating a system that not only prepares students for the future but also promotes responsible and ethical attitudes towards the environment and society.

The analysis of the information presented clearly demonstrates the wide and practical application of futures literacy in various fields. From the analysis of trends and early signals of change through the creation and use of future scenarios to the key role of creative thinking, futures literacy is proving to be an invaluable competence. It enables individuals and organisations not only to better understand potential futures but above all to actively participate in shaping them.

In the face of the increasing uncertainty and complexity of global challenges, futures literacy is becoming an essential skill to proactively respond to change, drive innovation and build a more desirable future. The interconnection of trend analysis, scenario planning and creative thinking within futures literacy creates a synergistic approach that strengthens the ability to anticipate and adapt.

Consequently, in an increasingly complex and rapidly changing world, futures literacy is gaining prominence as a key competency required to successfully navigate and consciously shape an uncertain future. Futures literacy is also an essential competence to support sustainable development. It enables long-term thinking, stimulates innovation through exploration of alternative futures, strengthens resilience to change and uncertainty, and inspires concrete action towards a sustainable future. Integrating Futures Literacy into education systems, policy-

level decision-making processes and organisational practices is key to promoting a more sustainable world.

It is therefore necessary to pay particular attention to developing this competence, and to carry out research in this area and monitor its development in society as a whole. Future research should focus on exploring the impact of futures literacy in the context of supporting sustainable development and on analysing the links between futures literacy and pro-environmental behaviour.

An interdisciplinary approach, combining knowledge from futures studies, environmental sciences, social sciences and other related fields, is essential to fully realise the potential of futures literacy in the pursuit of global sustainability.

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