Dynamic Capabilities: Toward an Assessment of Futures Literacy Competency

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Abstract

In recent years, the topic of dynamic capabilities has acquired new content. As higher-order competencies, they allow one to constantly update oneself with new knowledge, flexibly recombine resources, and adapt to a rapidly changing environment. A key part of dynamic capabilities is working with the future, starting with basic skills - futures literacy (FL). Since this competence is key to the human resources of organizations, its development seems important, starting with university programs. For a long time, there were no objective tools for measuring the degree of their mastery. The authors of this article attempt to fill this problem by offering an innovative approach to identifying and standardizing the assessment of FL competence. Six theoretical dimensions of FL are proposed as a basis for grouping assessment criteria and compiling final assessments and their interpretation. The corresponding dimensions, such as FL sub-competencies that include foresight, the assessment of future scenarios, and decision-making under uncertainty, can be assessed independently of each other. The ability to measure the initial level of FL will allow for the development of more effective educational programs for the development of this competence.

Keywords: dynamic capabilities; futures literacy (FL); skills evaluation; strategic thinking; futures studies; innovative thinking; Foresight; scenario planning.

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Introduction

In today's turbulent, rapidly changing environment, organizations need to develop dynamic capabilities to maintain strategic sustainability. This refers to building up the organization's potential to synthesize internal and external competencies, build them up, and recombine them in order to adapt. They reflect the ability to achieve innovative forms of advantage. This concept was first proposed in the mid-1990s in (Teece et al., 1997). In recent years, the number of publications on this topic has been growing dramatically. It is one of the most relevant topics in the expert discourse concerning development strategies in conditions of turbulence, complexity, and ambiguity. According to Google trends, at the turn of 2024 and 2025, the number of queries on this topic reached its highest value in the entire history of the concept. It is addressed by the world's leading universities, including Harvard, MIT, and Oxford, and journals on economics and business (such as Journal of Business Research, Strategic Management Journal, Research Policy, etc.). Dynamic abilities are considered a complementary addition to «ordinary» abilities. Both categories of abilities are used in different contexts.

Attempts are being made to build different lists and classifications of dynamic capabilities. These often include skills for working with multiple futures (futures literacy, FL), which involve a deep study and correct interpretation of socioeconomic challenges and prospects for their development as a basis for decision-making. Teaching this complex competence to support its implementation and the subsequent analysis of the results involves the integration of more methodological elements. This concerns the development of a reliable, valid, and objective data collection instrument for assessing the level of FL in line with the methodological foundations of the UNESCO concept (Miller, 2018; Bergheim, 2024). At the core of the academic tradition of FL training is the need to develop the individual capacity to imagine and use the future, while in a broader context the main interest is focused on the future of nature, communities and organizations.

Since developing skills in any area involves strengthening the ability to solve problems, it cannot just "arise" within people, but must be nurtured through learning, becoming a continuous process in which learning is measured at different levels of competence. This leads to the need to evaluate something tangible using certain criteria, procedures, and instruments. The study of characteristics and formation of conceptual bases for FL is desperately needed, but the process is not yet complete. This raises the question of whether FL can be codified and evaluated to consider it more than a simple scientific term.

At the most basic level, FL is related to strategic thinking. However, there are certain problems with the formation of this competence – both in the educational system and at business schools. Although our article focuses on the university environment, we look further into the corporate world, which is also investing in the formation of competences for working with the future, in the development of strategists capable of solving complex problems in a changing context. Today, even many companies are experiencing problems with the formation of these particularly sought-after competences.

Thus, billions of dollars (Moules, 2020) and hundreds of millions of hours are invested annually in training strategists (Doh, Stumpf, 2007). However, most of these investments do not pay off, since the competencies acquired during such training programs cannot be applied by the strategist in his/her workplace. Therefore, the question remains relevant: how can these programs produce a new result in the form of better quality work with the future. A significant gap has been identified between the content of knowledge about the corporate world taught at universities and its practical applicability. It would seem that university programs transmit "scientifically sound" knowledge, and they are taught in accordance with strict academic standards. However, when it comes to practice, this knowledge turns out to be inoperative, since it is based on outdated concepts that, although they were effective in the past (in previous conditions of stability and predictability), they have lost their relevance in the new turbulent, rapidly changing environment (Birkinshaw et al., 2016; Costigan, Brink, 2015). An effective way to overcome this gap is to learn to reformulate the existing problem, to look at it from a different angle, to go deeper, to pose the question in such a way as to arrive at a new question: to identify the next, deeper problem behind the known problem. "Digging to the roots" fundamentally changes the perception of the situation, a new space for tools for its solution opens up (Ramirez et al., 2021).

Business schools today are facing increasing pressure. They continue to train strategists focused on a narrow set of end goals, mainly aimed at increasing shareholder returns and short-term planning horizons. Meanwhile, external pressure and the number of stakeholders is increasing, requiring companies to train specialists in working with the future so that the strategies they develop can cope with complex, multidirectional processes. Thus, there is a growing demand for a new generation of strategists who are able to manage increased complexity and remain resilient no matter the volatility (Spanjol et al., 2023). The problem is that business schools are not doing a good job of teaching students

how to work with the future; the methods used to teach this work are outdated. At the same time, FL has a lot of untapped potential. In other words, rethinking the possibilities of FL can radically change the situation. In order for FL training to be more effective, it is necessary to improve the tools for teaching the relevant skills, introduce more relevant methods, and combine them in accordance with the specifics of the learning context, starting at the university level. A prerequisite for improving the educational methodology is the formation of a system of criteria by which the degree of assimilation of the taught FL skills by students is assessed. One way or another, the task is to prepare specialists with the relevant competencies, starting from the university bench. During the learning process, students are at a decisive stage of personal and professional development where their career track has not yet been determined, and they retain great potential for flexibility in the development of strategic behavior. With developed FL, students are better prepared for complex, turbulent processes throughout their careers (Miller, 2007). Various initiatives aimed at developing competencies for working with the future are already being implemented in different countries. However, this direction has not yet acquired a systemic basis, it has not become an integral part of broader educational programs and uniform standards for teaching such competencies have not yet been developed. In addition, a review of known publications on this topic shows the absence of special tools for objectively assessing the degree of assimilation of FL skills by students.

In an attempt to fill this gap, this article presents the author's tools for assessing the degree of students' acquisition of FL skills.

The article is structured as follows. First, we provide a brief history of futures science and the formation of the FL concept. Then the latest trends that make up the discourse in this area are described, examples of projects for the development of FL in the educational system and business are given. The remaining sections describe the methodology for compiling the questionnaire, the basis of the proposed toolkit for measuring the initial level of FL in students, the obtained results are then discussed, and conclusions are provided.

Literature Review

The FL concept describes an educational process aimed at developing people's abilities to think about the future, to view the current context through the lens of realistic future scenarios. On this basis, decisions are made and development strategies are formed to avoid undesirable tracks and implement preferred ones (Poli, 2021). Strategies are developed both at the individual level and at the collective, organizational level, including defining long-term development goals for a company or country and forming innovation policies (Miller, 2007, 2018; Karlsen, 2021). Let us consider approaches to the development of FL in the private sector and education.

FL, as a science of working with the future, has its own history. The idea of developing skills for dealing with the future as a basic competence "for the masses" (such as financial, digital, etc.) was first proposed in the 1970s (Toffler, 1970, Polak, 1973; Vygotskii, Cole, 1978). However, for several decades it remained outside the broader discourse. The situation changed in 2012, when UNESCO, represented by the head of the Foresight Research department, Riel Miller, began to create networks of special training laboratories for the development of these competencies in many countries (Miller, 2012). By that time, this concept had acquired a different meaning, becoming a synthesis of complexity theory and anticipation theory (Rosen, 1991; Louie, 2010; Nadi, 2012). The most significant role in the development of the FL concept and its translation into practice was played by the work (Miller, 2018). Thus, the science of the future entered a new historical stage of development. Different development institutions use their own terminology to describe it. Thus, in Germany (Stifterverband) and other countries they use the English names "Future Skills" or "Next Skills". The University of Dublin (Ireland) operates with the concept of "Transversal Skills". International organizations consider FL part of broader "21st century skills" (OECD, 2018, 2023), "Key Competences for Lifelong Learning" (European Commission, 2019). As part of "Next Skills", FL is closely related to "working with ambiguity", "ethical competence", "meaning-making", and "reflexivity" (Ehlers, 2024). In turn, the study (Lalot et al., 2020) operates with the concept of "Futures Consciousness", focusing on aspects such as "openness to alternatives." Regardless of the terminology, it is believed that skills for working with the future can be trained, developed, or strengthened in a variety of ways.

FL is considered through the prism of the classical definition of competence – as a set of knowledge, practical skills, and psychological attitude. Six of its components are distinguished (Table 1), which are interconnected, complementary, and upon one another.

From the point of view of FL leveling, four levels are distinguished (Bergheim, 2024):

Basic: Generally common to all people who imagine different futures and are somewhat open to new ideas and activities.

Intermediate: It is typical for people with heightened awareness, who are able to more deeply "draw" different versions of the future, comprehend them, and build their plans on this basis.

Table 1. **Components of FL**

Subcompetence	Description
1) "Complexity & Uncertainty Competence"	The future is viewed through the lens of complex adaptive systems (CAS), which are characterized by emergence, ambiguity, high unpredictability, etc.
2) "Multiple Futures Competence"	The diversity of possible paths is an integral characteristic of the CAS and these options can have different connotations in terms of perception (probable, desirable, etc.). The ability to work with such blocks as planning, self-organization, and optimization. Identify restraining factors such as "blind spots" and question the content of various data.
3) "Imagination & Assumptions Competence"	The future exists only in the imagination, so being aware of its images present in one's own consciousness and the consciousness of others, as well as the roots from which they arise, helps shape narratives.
4) "Reframe & Experiment Competence"	It is revealed through experiments, cognitive stretching, openness to the unknown, narrative practices, role-playing games, and living out individual scenarios.
5) "Novelty & Emergence Competence"	The ability to feel the difference between images of different versions of the future, to raise new, important questions that can open doors to new quests, to develop and accept unfamiliar situations, to explore new spaces and phenomena.
6) "Agency & Action Competence"	Knowledge of the connections between expectations, future images, and present action. Understanding the possibilities as well as the limitations of agency in the CAS. Identify strategies for different future images and develop roadmaps.

Source: authors, based on (Bergheim, 2024).

Advanced: Characteristic of those with strategic thinking who regularly update their knowledge of complexity theory, anticipation, foresight, and take part in strategic sessions.

Specialized: A small group of experts generating knowledge in the field of complexity science, anticipation, and foresight. They create new ways and methods of interacting with advanced systems and processes.

FL presented above has a logical connection with the multi-layer structure of the process of research into a multi-variant future (futures studies, FS) (Poli, 2021), reflected in Table 2. Each of the levels (layers) involves working with "known" and "unknown" aspects of the future. Thus, using these categories, one can explain the fundamental difference between forecasting and foresight. Forecasting is an attempt to "guess" the future, often based on the assumption that the future is a linear continuation of the present. In turn, the task of foresight is to outline different possible realistic options for the future, which forms the information basis for decision-making and strategy development, allowing one to avoid unwanted options and take steps toward the implementation of preferred options (Miller, 2018; Poli, 2017, 2019). Another key dimension that comes to the fore is the distinction between complex systems and CASs (Poli, 2013, 2017). The strategic environment of the 21st century is fundamentally different from the strategic environment of the 20th century, such that a truly complex organization requires a truly flexible structure to be resilient (McChrystal, 2019). This cannot be achieved without the majority of its members possessing FL.

When synthesizing these "contradictory" dimensions, a strategy of anticipation is developed, responsible for converting the accumulated knowledge base about the future into a roadmap of steps to implement preferred scenarios. In moving from the first layer to the fourth, and from known dimensions to unknown ones, the FL level is improved.

According to the works (Poli, 2021; Inayatullah, 2020), the development of FL as a competence is associated with the transition from less advanced to more advanced ways of using knowledge about the future. In this regard, the degree of aspiration to go beyond one's current environment to new horizons and heights, to get rid of the rut trap, and transform the life track is of key importance. This ability is distributed very unevenly across spaces and cultural contexts and has few areas of concentration. The ways in which knowledge about the future is used (or not used) serve as the basis for its development. Knowledge about the future as a tool embedded in actions that thus take the form of a strategy has a fundamentally different value compared to simple abstract reflection (Shutz, 1967). In the most general terms, one can contrast "passive" and "active" orientation to the future.

In relation to the field of education, this means that a passive orientation is expressed in the persistent widespread motivation to receive an education only for the sake of knowledge, without setting a specific life or career goal. With this attitude, the future remains unarticulated, appears as an implicit background for the educational process and does not have the potential to become a resource for proactive use (Miller, 2015). In contrast to a passive approach, there are types of active orientation, where knowledge about the future is built into the educational process. Most often, an active orientation to the future is expressed in optimizing efforts to achieve goals, taking into account the environment and relationships with other people (Facer, 2016). Contextual optimization is based on an understanding of what to expect and how to use resources in accordance

with the priorities. The future is seen as a background for making rational decisions, but the optimality of the choice can be judged, provided that the same set of criteria exists for evaluating all options. Optimization as a competitive advantage involves the acquisition of higher-order skills. However, various versions of "optimization" are becoming less and less viable options in today's turbulent world (Archer, 2013).

An effective alternative seems to be the development of educational programs based on work with contrasting scenarios and modeling immersion in unfamiliar experiences. Such conditions favor the development of innovative thinking and skills for recognizing new opportunities (Bloch, 1995; Poli, 2017). For this, safe learning spaces for experimenting with scenarios that have not yet been lived seem to be the optimal solution.

An additional factor of complexity in the process of FL formation is introduced by the diversity of intellectual traditions and practices of futures studies (Mangnus et al., 2021). Reflection on different modes of engagement with the future and an understanding of what these different approaches can offer for future-oriented action is recognized as fundamental to the development of FL. Different intellectual traditions and practices of futures studies make epistemologically different claims about the future and its manifestations in the present. Four main approaches were identified.

The first approach assumes that the future is at least partially known. The accompanying tools and methods consist of planning mechanisms and models to determine the probabilities of certain future events, including low-probability events with large-scale effects (wild cards), in order to mitigate risks.

The second approach starts from fundamental uncertainty about the future, favoring the conceptualization of several plausible forecast scenarios in order to test adaptive capabilities in these contexts. Methods such as quantitative modeling, scenario development, and horizon scanning are used.

The third way of engaging with the future aims to open alternative future paths through collective imagination using design, games, and other experimental and experiential interventions aimed at co-creating narratives.

The fourth, critical deconstruction, questions engagement with the "future". It asks how visions and ideas about the future are formed and how their political implications are assessed.

The approaches listed represent fundamentally different attitudes toward what it means to meaningfully engage with the future. Due to this diversity of attitudes toward the future and the different possible ways of engaging with it, the task of shaping FL turns out to be more difficult than it might seem at first glance. For example, confidence in the future is crucial for perceiving life as meaningful (Myllyniemi, 2017). The lack of a positive vision of the future can manifest itself, for example, in the choice of a suboptimal educational or career tracks, the growth of public fears, and other negative outlooks.

Thus, having FL depends on reflexivity regarding the different ways of interacting with the future and their effects. The interpretation of this concept always depends on the types of interventions currently carried out and on which pictures of the future are drawn (individually and collectively) and the ways of achieving them . Different practical results follow from this and there are grounds to speak about different levels of FL. The aforementioned four approaches to the future operate with different tools and practices, uniting people around specific images of the future and, accordingly, have different social functions. Some approaches open up more space for action, while others narrow this range (Stirling, 2008). Reflexive FL can contribute to raising awareness of different possible scenarios and

Table 2. **Multi-Layered Matrix of Futures Studies**

FS Levels	Futures Work Dimensions		Key Messages
	Known	Unknown	
Layer 4. Dance (Working with complex systems)	Studying complicated systems	Working with complex living adaptive systems	Learning to "dance" with complex adaptive systems
Layer 3. Ignorance (Working with incomplete data)	Risk assessment (events with a known probability of occurrence)	Delving into uncertainty (exploring possible events with an unknown probability of occurrence)	Ignorance is more relevant than knowledge (What we do not know is much more important than what we do know)
Layer 2. Deed (Focus on current activities)	Focus on mainstream trends (megatrends)	Exploration and identification of emerging processes, weak signals, potential jokers, and windows of opportunity	The future grows or shrinks according to our deeds (The chances of any scenario, whether desirable or undesirable, coming to fruition depend largely on our knowledge of them and the nature of the actions or inactions we take)
Layer 1. Action (Scanning the Future)	Forecasting	Foresight	Translation into action (The future is not predetermined, different scenarios for its implementation are possible)

Note: The layers are arranged in the matrix according to their hierarchy in relation to each other.
Source: authors, based on (Poli, 2021).

ways of realizing them. Reflexive forms of FL, regardless of approach, can deliberately and subtly guide future visions into a space of expanded possibilities. It is also possible to achieve an organic synthesis of different future regimes – "open" and "closed" – through interdisciplinary and transdisciplinary collaboration, especially if reflexivity takes on an institutional form.

The paper (Pouru-Mikkola, Wilenius, 2021) proposes the concept of transformative FL as a new paradigmatic framework for educational institutions, synthesizing the theories of transformative learning and FL. Transformative learning, based on a holistic approach, involves changing the frames of reference that determine the nature of people's interactions with the future. The goal is to develop a person's cognitive, motivational, and action-oriented abilities to interact with the future. "Frames of reference" describe the structures of assumptions through which life experience is understood: associations, concepts, values, feelings, and conditioned reactions (Mezirow, 1991). They shape and limit expectations, perception, cognition, and feelings. In the process of transformation, critical reflection on established interpretations and beliefs occurs.

FL development is based on the multidimensionality of human nature. For example, in the article (Ahvenainen et al., 2015), learning to work with the future is defined as a process that involves both rational and non-rational aspects of thinking, such as emotions and intuition. According to Gidley and Hampson (2005), FL training places excessive emphasis on the role of the cognitive dimension and the development of individual abilities. In turn, non-cognitive dimensions (empathic, creative, communicative, etc.) and collective learning are underrepresented, despite the fact that they also open up space for learning. The works (Rogers, Taff, 1996; Rogers, 1998) present a five-stage FL learning cycle, which was later used as an example of transformative learning (e.g. Siirilä et al., 2018; Sterling, 2010):

1. Cognitive: New knowledge acquisition, new ways of thinking, new perspectives.

2. Affective: Emotional responses to the newly gained knowledge, ranging from sorrow, despair, and anger to hope, acceptance, and courage.

3. Existential: Existential questioning of one's life, values and lifestyles caused by the two preceding phases.

4. Empowerment: Sense of personal empowerment and new clarity as one begins to consider how one can contribute to the future on a personal level.

5. Action: The sense of empowerment finds concrete manifestation in personal choices and social action for the building of a better future.

Thus, the combination of FL and transformative learning theories places a significant role in the learning experience of critically analyzing personal assumptions and emotions about the future, understanding new roles and perspectives, and finding ways to act upon new ideas.

FL Training – General Theoretical and Practical Considerations

FL labs are part of a limited portfolio of methods for working with "social complexity" (Aaltonen, 2009). They help people learn to engage creatively with the future and allow for ambiguity and self-organization (Bergheim, 2022). A large number of methods, grouped under the name "engineering approaches", rely on the ability of managers, experts, or researchers to understand, design, and control a system from the outside and to define clear rules. These include: environmental scanning, forecasting, text mining, roadmaps, scenarios and the "wheel of the future" (Aaltonen, 2009). Different methods used for different reasons in different situations require different methods of evaluation.

The educational process in most laboratories consists of four sequential stages (Bergheim, 2022), the overall goal of which is to make explicit and experiment with predictive models and assumptions.

Stage 1: "Reveal" (Phantom scenario). First, the student is asked to outline his *vision* of the future (phantom scenario). Then the reasons that made him assume such a course of events are revealed.

Stage 2: Reframe (Realistic Scenario): Students imagine the future through a lens that is fundamentally different from the phantom scenario, experimenting with a different set of assumptions.

Stage 3: "Rethink". The current context is viewed through the lens of the scenarios developed in the previous stages. New issues that were not previously recognized emerge.

Stage 4: "Action". The rehearsal of the action options developed in the three previous stages. Learning through action is carried out.

During the learning process, the necessary competencies are developed (the ability to work in teams, to form collective intelligence, to move through complexity and uncertainty in a state of certain stability, etc.) (Burns, 2015).

The second principle of the labs is to create collective intelligence, which allows students to experience different forms of perception and understanding, to better understand what they know and what they do not know, and to discover common patterns in complex processes. Rethinking transforms the mental-cognitive block. Different tools are used in this process. In some labs, educational sessions can be limited to a few hours, in others they stretch out over several days. Some labs

work with a small number of participants, while others involve hundreds. Some labs prioritize Phase 2, which promotes increased creativity, while others touch on it only briefly. Some labs focus on identifying and developing new ways of doing things in Phase 4, while others deliberately conclude the learning process with Phase 3 and rely on the energy of the participants to continue working independently with the new ideas identified after the lab session.

FL training is the training of teachers with the relevant competencies. The work (Kazemeir et al., 2021) presents a case study of the implementation of such an educational program. An assessment was made of the extent to which participants acquired three FL qualities that the program aimed to develop: improved perception of the future, acceptance of complexity, and a new sense of agency. The perceived value of the instructional strategies and program design was examined by the participants. All participants reported developing one or more FL qualities and noted the supporting role of the instructional strategies and program design. The need for additional research was identified to determine the content of the skills that make up FL and their assessment, taking into account the importance of such factors as students' personality traits, and their previous experience with the future.

Improving perceptions about the future is linked to the problem of people getting stuck in their "normalized" ways of thinking and acting, which are often taken for granted. A blind spot arises in relation to these factors that influence the nature of judgments and limit internal potential (Wals, Peters, 2017). People generally have difficulty expanding their imaginations toward emergent possibilities and transcending the limitations of ingrained assumptions about what is possible and probable now and in the future (Bell, 2002). The idea of the future is also influenced by subjective emotions and experiences, and by the views, values, and opinions shared in society (Rubin, 1998). The ability to think about the future is manifested in action: images and assumptions about the future influence actions in the present, which in turn contribute greatly to the shape that the future begins to take.

The development of FL seems to be one possible way out of this impasse. By abandoning the focus on forecasting and planning and instead diversifying the ways of seeing the world, it is possible to overcome anxiety about change and accept uncertainty and novelty as resources for development (Larsen et al., 2020; Nelson, 2019). FL thus allows one to embrace complexity, act in new and improved ways, and move beyond one's comfort zone (Damhof et al., 2020). Thus, in order to modernize the educational program on FL, one of the FL laboratories in Hansa (Germany) implemented a three-module teacher development program called Mastering Futures Literacy (MFL) in 2019. Each module addressed the task of developing one of the three FL qualities outlined above – improving the perception of the future, accepting complexity and gaining a new sense of subjectivity (from the performing approach to the transformative one). The idea was based on the idea of the gradual development of FL: the process begins with an improved perception of the vision of the future and the other two learning effects follow from this and can be intertwined. When the perception of the world changes, complexity and uncertainty cease to be a challenge. The design of the program was built in such a way that the participants felt like a community sharing common meanings. In this way, they gained the potential for integration into a wider network of FL training organizers (Kazemier et al., 2021). Following the training, university teachers expressed a commitment to creating spaces for experimenting with different futures in different contexts and building FL capacity in the wider community. Such initiatives are intended to contribute to the transformation of the established higher education system, as FL training goes beyond the incremental innovation processes and external quantitative assessment measures that dominate it. This increases the potential of the higher education sector to respond to large-scale and complex societal challenges.

Collaboration between Companies and Universities in the Formation of FL

There are expanding dynamics of cooperation between companies and universities in the development of FL. Companies from different sectors, mastering FL together with universities, create a knowledge spillover effect that enhances the educational potential of the latter and expands opportunities for experimental learning. One of the tools actively used in the corporate educational environment is scenario planning. Of interest is the teaching practice at Oxford University (UK) (Ramirez et al., 2021). The training takes place on "live" cases related to real strategic problems faced by one of the participant learning groups. Live cases are flexible learning tools for exploring the future through scenario planning. One of the skills acquired here is the ability to identify the real deep roots of a persistent problem. Through a collaborative search, the members of the study group discover the "question behind the question," which leads to a breakthrough solution.

The work (Toivonen et al., 2021) is also worth attention, since it assesses how the use of different teaching methods affects FL proficiency in the context of Finland and Sweden. Four student test groups (373 participants) took part in special training programs on work-

Table 3. **Description of Thematic Categories for the Distribution of FL Assessment Criteria**

Component	Functions for working with images of the future
Forecasting	Focus on generalized forecasts of imaginary futures based on extrapolations from the past.
Fate	Specific and unique imaginary futures based on fatalistic stories or entrenched myths.
Creative reform	Use of imaginary futures to solve known problems in innovative ways.
Self-improvement	Imaginary futures oriented toward the appreciation of process and ephemerality, with endogenous creativity.
Strategic thinking	Imaginary futures to perceive and make sense of the emergence of phenomena in the present, focused on repetitive phenomena.
Tao-being wisdom	Imaginary futures to make sense of the emergence of phenomena in the present, focused on unique and locally specific attributes.

Source: authors, based on (Miller, 2018).

ing with the future. Two groups tested the "wheels of the future" method, the third — the development of scenarios, while the fourth limited itself to listening to theoretical material. The task was to achieve three levels of FL "awareness – discovery – choice" (Miller, 2007, 2012), the result of which is the growth of the potential of transformative subjectivity. The testing of acquired knowledge and skills showed different levels of effectiveness for the different methods. As a rule, achievement of higher levels of FL was declared by those who were involved in more practice-oriented methods. At the same time, additional difficulties and limitations were noted in the implementation of the methods of "scenario planning" and the "wheel of the future" in decision-making practice. The following were noted: the high complexity of working with the future, deep involvement, and a weak understanding of how to operate the results. The findings of this study are equally useful for university teachers and companies seeking to establish more constructive interactions with local communities.

The literature review demonstrates existing proposals and approaches for the use of FL. However, before embarking on educational projects in this direction, the contextual features of the initial attitude of prospective students toward the future should be carefully studied. The development of FL is seen as a guarantee that company and university projects will have social significance and comply with the principles of sustainable development. The need to assess the initial level of FL in students is emphasized so that training programs can be planned more effectively, taking into account many aspects (Mangnus, 2021). Although the cases presented in the aforementioned works (Kazemier et al., 2021) and others demonstrate sufficient signs of development of the target competencies, the research tools used by their authors are not able to provide an objective assessment of the degree of acquisition of FL skills, since all the conclusions made are based on the opinions of the respondents themselves. The need to develop an objective multi-criteria tool for assessing the acquisition of FL skills by students to improve the effectiveness of educational programs is the purpose of our study.

Methodology

The main objective of the study is to contribute to standardizing the measurement of the starting level of FL in students, with which work will be carried out to increase it. Such a tool will be relevant for anyone engaged in futures research and especially those who implement educational projects in this direction. For this purpose, a questionnaire was circulated, the questions of which were grouped according to the six components of FL identified in the work (Miller, 2018) (Table 3). UNESCO's developments in the creation of educational laboratories in this area were used (Miller, 2018; Bergheim, 2024a). The questionnaire was validated by nine academic experts in the field of futures studies. The results were analyzed using Aiken statistics (Aiken, 1985). On this basis, adjustments were made to the questions.

It was pilot tested on a sample of students from a state university in Mexico. The survey involved 256 students over the age of 17 years old as shown in Table 4. Of the total number of respondents, more than two thirds (173 people) were women, which indicates their increased interest in the proposed questionnaire.

The questions were distributed into six FL categories and are presented in Table 5. Respondents were asked to choose one of five answer options to assess the probability – an indicator of the degree of their confidence in the answer: maximum, high, medium, low, and minimum. A five-point Likert scale was used to measure the answers. The questionnaire was carried out with using the Microsoft Forms web application.

Results

The next research stage consisted of the assessment of the statistical reliability of the answers obtained using exploratory factor analysis (Hair et al., 2019), KMO tests (Kaiser, 1974) and Bartlett (1954) and Cronbach's alpha coefficient calculations. Data processing was carried out using the statistical software package SPSS. To describe the results of the analysis, a set of factor and structural matrices was constructed.

Table 4. **Frequencies - Age and Gender of the Respondents**

a) Age

Valid	Frequency	Percentage	Valid Percentage	Cumulative Percentage
	3	1.2	1.2	1.2
17	20	7.8	7.8	9.0
18	61	23.8	23.8	32.8
19	44	17.2	17.2	50.0
20	38	14.8	14.8	64.8
21	38	14.8	14.8	79.7
More than 21 years	52	20.3	20.3	100.0
Total	256	100.0	100.0	

b) Gender

Valid	Frequency	Percentage	Valid Percentage	Cumulative Percentage
	3	1.2	1.2	1.2
Man	79	30.9	30.9	32.0
Woman	173	67.6	67.6	99.6
Not specified	1	0.4	0.4	100.0
Total	256	100.0	100.0	

Source: authors.

In total, six main factors were analyzed, in which group elements related to different sub-competencies. FL (the ability evaluate future scenarios, make decisions under conditions of uncertainty, "play ahead", etc.).

Trends in the responses of the surveyed students were identified using descriptive statistics. The values of the Cronbach's alpha coefficient in all cases were greater than 0.8, which reflects the high reliability of the selection of aspects characterizing competence and FL. They can be considered a guarantee that the wording of questions in each group describing the corresponding FL component correlates, measuring similar constructs.

Exploratory factor analysis (EFA) was conducted using maximum likelihood with Oblimin oblique rotation and Kaiser normalization. Results are reflected in Table 6.

The structural matrix presented in Table 7 demonstrates the general correlations between the items and their underlying factors. Its components reflect a significant correlation with the expected factors, confirm-

Table 5. **Survey Questions and their Distribution by FL Categories**

Forecast
R1. Do you use statistical, historical, or context information to evaluate options before making important decisions related to your career? R2. Do you keep up to date with information or the latest trends and advances in your field of study? R3. Do you know how to identify trends that could impact your future career? R4. Do you know how to identify early alerts/signals about significant changes in your field of study?
Destiny
R5. Do you believe that there is a single future in which people's events or actions are predetermined? R6. Do you believe that there is an order and destiny of things that cannot be changed? R7. Do you think that no matter what is done, the conclusion of the world will be the same?
Creative Reform
R8. Are you capable of planning projects in the present considering their results in the medium or long term (10 or more years in the future)? R9. Do you conceptualize futuristic ideas and express them through models, prototypes, or other creative means to facilitate their understanding in the present and their results in the future? R10. Do you use scenarios to transform your ideas about the future into actions that help solve current problems?
Self-Improvement
R11. Are you willing to take on additional responsibilities to advance your goals? R12. Do you strive to set ambitious and meaningful goals in your academic and professional life? R13. Do you take the initiative to address situations before they become problems? R14. Do you actively seek opportunities in your field of study or work rather than waiting for them to rise? R15. Do you think of innovative solutions to problems in your academic or professional life?
Strategic Thinking
R16. Do you use short, medium, and long-term goals for your professional and personal future? R17. Do you use strategies to identify and take advantage of future opportunities in your field of study? R18. Do you anticipate possible problems and take preventive measures in your studies or work? R19. Do you consider the medium and long-term consequences of your current actions and decisions in relation to your career? R20. Do you have contingency plans in case you have to face unexpected changes in your academic or professional life?
Wisdom-Tao-Being
R21. Are you able to identify possible challenges or changes in your academic or professional environment before they occur? R22. How perceptive are you of emerging events in your environment to associate them with future events that could impact your field of study or work? R23. Do you believe you are prepared to face local challenges with global awareness in a proactive way in your area of study or work?
Source: authors.

Table 6. **KMO and Bartlett's Test**

Kaiser-Meyer-Olkin Measure of Sampling Adequacy		0.903
Bartlett›s Test of Sphericity	Approx. Chi-Square	1950.695
	df	253
	Sig.	0.000

Source: authors.

ing the validity of the proposed tool structures. The items with the highest correlation are related to questions R19–21, which showed a strong positive correlation with Factor 1 (loadings of 0.776, 0.639 and 0.625 respectively). There is reason to believe that these items reliably reflect the theoretical dimension represented by the mentioned factor.

On the contrary, some items also present negative loadings (e.g., R21 with Factor 3, loading of -0.439), which indicates inverse relationships between some items and non-dominant factors.

At the same time, the pattern matrix (See Table 8) was key to understanding the pure loadings between items and factors, excluding indirect influences from other factors. This matrix made it possible to clearly identify which items are more strongly related to each factor, disregarding possible cross-influences from other factors. For example, item R6 showed a strong loading on Factor 2 (0.824), confirming its direct association with it. In contrast, some items such as R12 presented more complex factor loadings, showing both a strong negative relationship with Factor 3 (-0.772) and a moderate positive one with other factors, which may suggest the need to revise this item or its interpretation in further studies.

Each factor is composed of items that correlate coherently, which confirms the validity of the structure initially proposed in the theory. However, some items presented minor cross-loadings with more than one factor, suggesting the need for further revisions or the refinement of the questionnaire in future studies.

The variables are grouped into three factors that according to the proposed literature review can be named as follows: F1 (specific knowledge), F2 (scalable knowledge), and F3 (awareness of the future).

Discussion and Conclusions

Previous studies in the FL area, for example (Kazemier et al., 2021; Pouru-Mikkola, Wilenius, 2021), emphasized the need to develop educational tools that promote long-term thinking in university contexts. In response to this need, our study proposes an innovative approach to identifying and standardizing the assessment of students' FL competence. Statistical computing confirms the reliability of the questionnaire we developed to measure the level of FL in students, since

Table 7. **Structure Matrix**

	Factors					
	1	2	3	4	5	6
R21	0.776	0.312	–0.439	0.517	0.236	
R19	0.639		–0.447	0.385	0.229	0.443
R20	0.625		–0.36	0.292		0.159
R18	0.623	0.212	–0.497	0.455	0.219	0.383
R22	0.6	0.217	–0.399	0.523	0.221	
R23	0.504	0.2	–0.386	0.501	0.224	
R6	0.13	0.824		0.134	–0.12	0.114
R7		0.631			0.399	–0.162
R5	0.178	0.595		0.192	0.161	
R12	0.394		–0.772	0.388	0.176	0.329
R11	0.346		–0.763	0.371	0.19	0.326
R13	0.47	0.132	–0.654	0.445		0.108
R17	0.541	0.178	–0.614	0.439	0.531	0.336
R14	0.516	0.168	–0.602	0.406	0.308	0.109
R15	0.566	0.222	–0.583	0.472	0.183	0.252
R16	0.462	0.127	–0.527	0.369	0.484	0.414
R4	0.372	0.212	–0.433	0.694	0.271	0.124
R3	0.383		–0.427	0.643	0.177	0.141
R9	0.44	0.331	–0.348	0.571	0.281	0.192
R1	0.295		–0.273	0.567	–0.174	0.183
R2	0.301		–0.301	0.522		0.109
R8	0.47	0.174	–0.359	0.482	0.311	0.154
R10	0.38	0.119	–0.536	0.395	0.134	0.586

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.

Source: authors.

Table 8. **Pattern Matriax**

	Factors					
	1	2	3	4	5	6
R21	0.681	0.124		0.141		–0.158
R20	0.655					
R19	0.551	–0.108				0.314
R18	0.426		–0.112	0.102		0.247
R22	0.420			0.277		
R6		0.890			–0.281	0.173
R7		0.597		–0.176	0.311	–0.115
R5		0.566				
R11			–0.775			
R12			–0.763			
R13	0.155		–0.605		–0.196	–0.125
R14	0.223		–0.451		0.144	
R15	0.285	0.110	–0.335	0.114		
R4				0.660	0.180	
R3			–0.112	0.586		
R1				0.571	–0.243	
R2				0.488		
R9	0.114	0.204		0.456	0.168	0.103
R8	0.232			0.317	0.210	
R23	0.283			0.306		–0.139
R17	0.188		–0.318		0.394	0.166
R16	0.155		–0.228		0.377	0.284
R10			–0.285	0.122		0.465

Extraction Method: Maximum Likelihood. Rotation Method: Oblimin with Kaiser Normalization.

Source: authors.

it ensures the high accuracy of coverage of the competence in question. Exploratory factor analysis (EFA) and reliability calculations using Cronbach's alpha testify to the high consistency of the components of the proposed assessment tool.

In particular, the results of the factor analysis confirm that the proposed six theoretical dimensions of FL are a relevant basis for the design of corresponding university programs. It is shown that working with images of the future is not just an abstract ability, but a competence subject to assessment through a rigorous approach (Miller et al., 2018; Karlsen, 2021).

Through the EFA, clear groupings of the elements of FL across six main factors indicate that sub-competencies ("foresight", "evaluation of future scenarios", and "decision making under uncertainty", etc.) can be assessed independently of one another. The high correlations between the items and their corresponding factors, reflected in the structural matrix, confirm the structural validity of the proposed instrument. However, some items show minor cross - loadings with more than one factor, indicating the need for further revision to improve content clarity and theoretical coherence. Items with negative loadings on non-dominant factors, such as item 21 in Factor 3, require in-depth consideration to determine whether they need to be reformulated or excluded from the questionnaire.

To further validate the structure we have identified, it is advisable as part of further research to conduct confirmatory factor analysis (CFA). Thus, the assessment of the potential for reproducibility of the proposed theoretical factors in the different samples of respondents will become more substantiated, due to which the generalizability of the instrument will be demonstrated.

Developing and testing the submitted questionnaire contributes not only to the field of futures studies, but also offers a new assessment tool for universities. The ability to measure the initial level of FL in students will allow for the development of more effective educational programs to develop this increasingly in-demand skill.

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