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Review

Contributions of the 9-Layered Model of Giftedness to the Development of a Conversational Agent for Healthy Ageing and Sustainable Living

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Abstract: The 9-Layered Model of Giftedness is an innovative conceptual framework composed of an integrated set of abilities, skills and values that align with Goals 3, 4 and 8 of the UN Sustainable Development Goals for 2030: Good Health and Well-Being, Quality Education, and Decent Work and Economic Growth, respectively. The corresponding hierarchical model considers metacognitive abilities, such as attentional control and self-regulation, as well as personal values and attitudes towards life, such as sustainability and inclusiveness, as major qualitative criteria encapsulated in the construct of giftedness, thereby reframing intelligence per se into collective intelligence. Moreover, a chatbot was developed, incorporating knowledge and computerised tools organised into modules that support lifelong learning—a key metacognitive competency for the Industry 4.0 era—thereby enhancing personal and professional development.

Keywords: inclusiveness; cognitive flexibility; adaptability; lifelong learning; giftedness; chatbot; healthy ageing; sustainability

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1. Introduction

The current study presents an innovative conceptual model of giftedness in the Industry 4.0 era. This integrated construct of abilities, skills and values stems from the human need to evolve and adapt to emerging social and economic models. A gifted person needs to think and act in compliance with certain values and attitudes that serve individual and social thriving as a common human purpose.

Moreover, the current article outlines the methodologies and techniques related to the training and assessment of the cognitive and metacognitive skills pertaining to the 9-Layered Model of Giftedness [1]. The 9-Layered Model of Giftedness encapsulates the triangular relationship among intelligence, consciousness and giftedness from an interdisciplinary perspective, thus requiring in-depth research in the fields of AI, brain science, psychology, education science, computer science, engineering and human–computer interaction.

The 9-Layered Model of Giftedness places emphasis on the role of education and lifelong learning in the evolution of intelligence in order to reach one's highest cognitive capacity and mental state, which is self-consciousness [2]. In this sense, giftedness is conceived as a dynamic construct of cognitive abilities, values and self-beliefs concerned with the accomplishment of self-awareness, self-knowledge and self-control. Therefore, a gifted person is someone who acquires the abilities and mindset to self-orientate towards environmental and social sustainability in full convergence with the United Nations' Goals and Guidelines.

In this hierarchical model, each level corresponds to a consolidated set of abilities, skills, values and self-beliefs that are dynamically and reciprocally related. The ranking

in cognitive and mental capacity stems from the metacognitive components included in individuals' abilities, skills and values [2]. Furthermore, giftedness is perceived as a self-centred and dynamic process, affecting one's behaviour and choices to the benefit of the individual and society as a whole. The current model is illustrated by in-depth research in cognitive functions, abilities, skills, values and self-beliefs, orchestrated in a hierarchical model, focusing on the efforts and strengths needed for attaining individuals' highest cognitive and mental state, self-consciousness. In addition, self-consciousness is innately related to sustainability as a personal and social value [2].

Therefore, the current article presents a formal model including the 9-Layered Model of Giftedness, the validation and reliability analysis of the Cognitive and Metacognitive Self-Assessment Tool as well as the description of the prototype of a conversational agent developed as an innovative e-learning tool to promote cognitive and metacognitive skills and address healthy ageing and sustainable living purposes. More specifically, the agent is structured in modules that merge human consciousness with the capabilities of artificial intelligence, aiming to enhance personal and professional development in alignment with the EU Priority, Key Competences for Lifelong Learning, and the UN's Sustainable Development Goals by 2030, namely Goal 3: Healthy Living and Well-Being, Goal 4: Inclusive and Quality Education, and Goal 8: Decent Work and Economic Growth [3].

2. Materials and Methods

2.1. Research Design

The 9-Layered Model of Giftedness was designed based on a review study published in 2017 [1]. The model was conceived in the process of reviewing studies about cognitive and metacognitive skills and their relevant brain functions [1–6]. Notwithstanding, the trigger point for the development of the model originates from the needs and challenges reflected in the evolution of human intelligence, initiated by the Industry 4.0 era, an era characterised by collective intelligence and systems thinking. This study enriches and updates the content of the conceptual model and provides a reliability analysis of the Cognitive and Metacognitive Self-Assessment Tool, a tool that was structured based on the 9-Layered Model of Giftedness. Moreover, the authors present a conversational agent as an e-learning tool aimed at cognitive improvement and behavioural enhancement for personal and professional development, combined with potential use-case scenarios for the implementation of the chatbot.

The total number of items reviewed for the current study is 500. The review adheres to the PRISMA 2020 methodology to establish a foundation for the design, aim and structure of the conversational agent (Figure S1).

The extraction process for making the final list of research material to be included in the review lasted three months (October 2023–January 2024), and the review was conducted via two search engines: Google and Google Scholar. The keywords used were cognitive abilities, cognitive improvement, cognitive function, mental health, cognitive health, cognitive assessment and theories of personality. Since the authors have already conducted in-depth research in computerised cognitive and metacognitive skills training and assessment tools in the framework of a longitudinal, interdisciplinary study, the risk of methodological bias in the current research is limited. Furthermore, the results of the present article align with the previous studies conducted by the authors, offering a constructive, elaborative and progressive scope.

The model constitutes a holistic, personal and professional development framework based on cognitive and mental health proactive training and assessment in the aspects outlined in the following sections.

2.1.1. Cognitive Health

The model is structured on a set of cognitive abilities and skills in combination with values and self-beliefs, which are intertwined and reciprocally related in a dynamic construct. In general, the model is centred on the interplay between the physiological and

psychological processes affecting intelligence, with emphasis on the effects of quality education and lifelong learning on cognition and emotions [4].

Moreover, the current model includes an innovative theory about giftedness that follows a holistic approach, encompassing individuals' abilities, skills and personal characteristics. According to our research, giftedness is a multi-componential construct, embracing individuals' brain capacity as well as their personal characteristics and personal qualities, such as perseverance, stamina, volition and courage [5].

This model covers a wide variety of physiological and psychological factors as well as self-beliefs and values affecting individuals' personal and professional development. According to the model, a gifted person acquires the abilities, skills and an entire mindset that can lead to personal and professional development by preserving a balance between personal success and societal welfare [1]. A gifted person can use cognitive and emotional attributes, such as perseverance, resiliency, determination and self-respect, to attain a society of individuals based on the principles of social equity and inclusiveness. In short, this model launches multiple training tools and methods regarding an individual's cognitive and mental capacity enhancement. These methods and techniques range from establishing routines and modelling behaviour to maintaining a supportive and reliable social environment [6].

The levels of this hierarchical model correspond to upskilling and reskilling an individual's cognitive and mental capacity as follows: The first level corresponds to the initial level of a person's natural abilities. The second and third levels encapsulate higher cognitive skills, such as sequential thinking, problem solving, embodiment and critical/creative thinking. The fourth and fifth levels embrace intrapersonal and self-regulation skills, respectively, combining metacognitive components of intelligence as preconditions for the expression of any type of gift/talent or reaching personal excellence. Finally, upper cognitive and mental states are related to being self-conscious and having an overview of matters. These are universal knowledge creation and self-transcendence for full mental and spiritual empowerment. Finally, consciousness entails being aware of the fact that each person and entity has a unique place among others, forming a unity. Top-level mental states, such as self-consciousness, are the bricks and mortar of brain health [1].

Notwithstanding, the 9-Layered Model aims to enhance AI models by mapping cognitive abilities, skills, values and self-beliefs in order to set the grounds for improving the methodologies and digital tools used by scientists in the fields of education and cognitive science [7].

As far as the physiological and psychological substrates of intelligence, positive mood and cognition are related to physical and mental exercise operating synergistically, as pointed out by the notable increase in neurogenesis in an enriched environment [8,9]. More specifically, the levels of brain chemicals, such as hormones and neurotrophins, which are related to neurogenesis and neuroplasticity, are also environmentally dependent, and they can be enhanced through everyday living conditions and activities, such as food intake, meditation, physical and mental exercise, and sleeping habits [10–12]. On the other hand, it has been found that people facing a prolonged period of loneliness or anxiety demonstrate different brain architecture and activity [13–15].

Furthermore, mindfulness training activates frontal lobe functioning and improves attentional control [16–19]. Also, loving-kindness meditation (LKM) encompasses cognitive and emotional processes, focusing on humanity, compassion and self-transcendence. Loving-kindness meditation (LKM), in combination with focused-attention meditation (FAM), activates the entire brain [20,21].

In addition, mindfulness meditation diminishes exposure to stress, thus counterbalancing deficits in emotion regulation, e.g., anxiety disorders and depression [22]. Therefore, cognitive and mental processes are reciprocally related and directly affect individuals' cognitive and mental health [23]. Attentional control and cognitive flexibility have already been related to positive mood [24].

It is worth noting that when individuals experience stress, let alone chronic stress, the neurophysiological processes taking place in the body wear the brain down, interrupt the vagal tone, disrupt synapse regulation, impair brain function and compromise one's mood [25,26]. Moreover, chronic stress increases the risk of chronic fatigue, dementia, Alzheimer's disease and other neurodegenerative diseases due to DNA methylation resulting in changes in the expression and characteristics of genes [27,28].

2.1.2. Theories of Personality

Bandura's social learning theory places emphasis on attentional control (selective, sustained, focused attention) as a metacognitive skill that has a direct impact on one's self-efficacy, self-reinforcement and self-reward. Bandura's social learning theory and the 9-Layered Model of Giftedness are founded on the significance of higher cognitive skills in learning processes, such as critical/creative thinking, problem solving, and intrapersonal skills, such as self-efficacy beliefs and self-regulation skills [29]. Also, both theories view learning capacity as a dynamic construct formed by personal characteristics and social environment. Therefore, both theories point to the role of educators as constant inspiration for students and trainees, and they underline the role of self-efficacy belief as a predictor of learning [30].

Moreover, according to Vygotsky's theory, human interaction, such as in the case of parents/teachers and children, and peer interaction, is very critical to a child's intellectual growth [31]. Mental structures are constructed and reconstructed within the brain, and this adaptation is analogous to the genetic adaptation of evolving species, according to Piaget's stages of internal organisation [32]. In advance, how and what one thinks and how the person interacts with the environment represents that person's knowledge background and the foundation of that person's intellectual development [33].

More specifically, Vygotsky's theory of social constructivism and the 9-Layered Model of Giftedness place special emphasis on the environmental factors that have a strong impact on personal growth and behaviour. Learning affects one's abilities, skills and values [34,35]. Learning is related to individuals' personal characteristics and, thus, their behaviour. Such values are persistence, patience, endurance, self-improvement and self-knowledge. These values are centred on human potential for personal evolution. Therefore, learning of all types, either formal or informal, can bring personal and social well-being [36].

Also, Piaget's theory is closely linked to the 9-layered Model of Giftedness as they both encompass neuro-cognitive changes affecting human behaviour based on systemic changes, biologically and environmentally defined through the enhancement of self-regulation processes originating from education [37].

Aristotle explained that human behaviour is intrinsically related to personal values, such as the capability to discern right from wrong [38]. Moreover, he noted that perception is a key cognitive skill that enables applying knowledge to new experiences (metacognition). Prudence, volition, judgement, memory, perspicacity and foresight compose Aristotle's character excellence. He also spoke of the knowledge created by individuals while observing nature and its axiomatic system (theoretical intelligence) [39]. Finally, Sternberg identified analytical, practical and creative intelligence, encompassing cognitive and metacognitive processes, following certain stages in knowledge acquisition, knowledge formation and knowledge evaluation [40,41]. Analytical intelligence reflects on standardised training and assessment processes used mainly in schools. Practical intelligence places emphasis on embodied knowledge and everyday problem-solving situations while conceiving knowledge through observing others. Finally, creative intelligence consists of innovation and entrepreneurship based on prior experience and knowledge [42].

2.1.3. Diet and Lifestyle

This model suggests a healthy lifestyle, especially physical training, in addition to chronic consumption of PUFA-enriched diets to induce attentional control and other executive functions [43]. By healthy living, it is insinuated that the person has a healthy

diet, engages in physical exercise, enjoys healthy sleeping patterns and abstains from addictions [44]. Moreover, healthy and quality living translates to more productive and effective work.

This model takes a cross-disciplinary look into several scientific fields with the aim of emphasising natural food, including herbs and spices that have antioxidant, anti-inflammatory and cognitively protective ingredients to set the grounds for the design of new food products that can be characterised for their multiple nutritious and beneficial roles [45]. Moreover, the model insists on the best practices regarding the life cycle of the aforementioned natural foods, such as the natural conditions necessary for their growth and for maintaining their properties. Also, special focus is given to the deployment of the principles of the circular economy in the design and consumption of new food products [46].

In addition, this model takes into consideration the 2030 UN Sustainable Development Goal 3, Healthy Living and Well-Being, in combination with the World Health Organisation Action related to preventing health issues and promoting physical, social and mental well-being throughout life. Moreover, sustainable development relies on cooperation and continuous information exchange among consumers, industries and states within a framework of preserving stakeholders' mutual viability and sustainability. Therefore, consumers, industries and the state are equal predictors of the United Nations' Sustainable Development Goals by 2030. Industries can design and produce new products with an emphasis on human and environmental health, for incorporating the zero waste and carbon reduction policy of the EU. Consumers, through conscious eating and buying, have an impact on sustainable living and healthy ageing. States can develop technologically advanced tools to enhance interactivity and communication among all interested parties [47].

2.1.4. Education and Lifelong Learning

The 9-Layered Model of Giftedness is a framework that can be used in educational and lifelong training modules implemented in integrated and proactive physical, cognitive and mental health programmes [48,49]. In general, lifelong learning is reciprocally related to higher cognitive skills, such as cognitive flexibility and self-regulation skills; thus, a tailor-made educational and training experience can lead to the synergistic development of individuals' cognitive and emotional components in addition to enhancing employment, social affairs and inclusion [50–52].

More specifically, the 9-Layered Model of Giftedness conceives cognitive abilities and skills training as a dynamic, lifelong learning process with the aim of promoting active and healthy ageing [53]. In addition, lifelong learning enhances self-efficacy beliefs and motivation for self-improvement towards personal and professional development. Therefore, the 9-Layered Model of Giftedness provides the framework for the development of an integrated physical, cognitive and mental health proactive programme in line with lifelong learning as well as healthy and active ageing EU programmes [54].

Furthermore, the core cognitive abilities and skills for promoting the personal and professional development of EU citizens in relation to achieving quality education and lifelong learning in EU Member States are the following [55,56]:

- Creative and critical thinking, problem solving and decision making;
- Empathy;
- Media and digital literacy;
- Resilience and cognitive flexibility;
- Communication and cooperation;
- Entrepreneurship and innovation;
- Self-regulation;
- Self-leadership and self-improvement;
- Inclusiveness.

Effective inclusion strategies in schools and society as a whole rest on a social ethos [57]. The social ethos affects the school climate in the sense of social learning and performance

in a society characterised by humanitarian values. Also, of great significance for fostering inclusive practices in schools is building positive and purposeful relationships throughout the school community. The 9-Layered Model of Giftedness provides an integrated approach towards improving the human mind and behaviour, encompassing both the skills and personal characteristics (personal virtues, values, motivation) for promoting inclusiveness and sustainability in all social contexts [58,59].

Inclusive societies and active citizenship are EU pillars that can be realised by embracing a holistic education reform [60]. The 9-Layered Model of Giftedness can serve as a cornerstone in the attempt to reform national and European, formal and informal, educational curricula towards inclusiveness [61,62]. The model embraces the techniques and methodologies to acquire key competences and higher cognitive skills, and it provides assessment tools that enable all interested parties to identify their upskilling needs [63,64].

2.1.5. Theories of Motivation

Herzberg's theory and the 9-Layered Model of Giftedness have found common ground on the significance they place on human motivation and, especially, intrinsic motivation. Intrinsic motivation is related to intrapersonal skills via the creation of self-beliefs; thus, intrapersonal skills are the foundation of motivation. Intrinsic motivation also rests on the need for social connection for personal and social causes [65,66]. Moreover, according to Herzberg's theory, democratic organisations, which enhance the free expression of ideas, elevate employees' intrinsic motivation, job satisfaction and performance levels, and thus overall organisational effectiveness is increased [67].

Human resources development is critically related to creating motivation towards employees' personal and professional development to achieve full and productive employment as well as sustainable economic growth [68]. Professional development rests on the enhancement of a person's hard and soft skills via lifelong learning opportunities [69]. In addition, a manager should be able to guide and inspire the subordinates in adopting and implementing 21st-century skills and, most importantly, communication and cooperation in order to attain a better level of employee engagement, coordination and entrepreneurship. Employee engagement is innately related to their intrinsic motivation level [70].

Furthermore, entrepreneurship and innovation are also assets for all organisations, offering mutual benefits both to the individuals and the business communities in which they operate. Also, self-leadership and self-management are cognitive abilities that empower employees to engage in lifelong learning activities for personal and professional development [71,72]. Self-motivated employees play a vital role in commerce, trade and economic growth in many nations through the integration of technological innovation [73]. However, successful managers should also endorse their employees' skills and supportive attitude towards fellow colleagues by giving them credit for sharing their knowledge, skills and ideas in favour of a shared common vision [74,75].

2.1.6. Validation and Reliability Analysis of the Cognitive and Metacognitive Self-Assessment Tool

The Cognitive and Metacognitive Self-Assessment Tool, a computerised self-evaluation questionnaire with 48 items based on a 5-point Likert scale, follows a progressive structure. It is worth mentioning that the questionnaire had already been tested twice on a trial basis and certain improvements were made in its syntax. The questionnaire is in Greek, and it is expected to show a four-ranking order of abilities, skills and attitudes, as follows [76]: (a) initial cognitive skills capacity, (b) higher cognitive skills capacity, (c) top-level cognitive skills capacity and (d) top-level mental stance. Item scores range from 1 (low) to 5 (high).

2.1.7. Data Analysis

The questionnaire was answered by 309 individuals and 306 valid answers were recorded. Cronbach's alpha as a measure of the internal consistency of the tool equals 0.933. Each layer encapsulates the sets of skills of the previous levels, adding an additional set.

The statistical descriptors of each layer that reflect the hierarchical structure of the tool are described in Table 1 [77].

Table 1. Score for each layer measured by scale mean and item means, and reliability scores measured by Cronbach's alpha.

Layers	Scale Mean	Item Means	Cronbach's Alpha
Layer 1: Variables 1–12	48.75	4.059	0.827
Layer 2: Variables 13–24	48.63	4.050	0.788
Layer 3: Variables 25–36	46.22	3.756	0.818
Layer 4: Variables 37–48	45.85	3.914	0.822

2.1.8. Results

According to Table 1, users self-evaluate themselves as being less capable of behaving in ways that necessitate advanced metacognitive skills; thus, metacognition is at the apex of cognitive and mental capacities. Moreover, the tool embraces values and self-beliefs integrated into top-level cognitive skills capacity and top-level mental stance. Each layer consists of 12 variables with high internal consistency, structured in four total layers. The hierarchical structure is explained by the role of metacognition as a latent variable in all layers of cognition. Moreover, the hierarchical structure of the model is explained by the fact that each layer entails the set of abilities, skills, values and self-beliefs of the previous layers.

As a result, the Cognitive and Metacognitive Self-Assessment Tool is found to align with the 9-Layered Model of Giftedness as far as the significant role of metacognition in intelligence and giftedness. Giftedness is perceived as a multi-faceted construct with an emphasis on metacognitive abilities and skills as transversal competences for personal and professional development. The results indicate that individuals' general cognitive and mental capability is a dynamic construct, and it can be enhanced through training methodologies, techniques and tools concerned with metacognition, such as mindfulness and self-consciousness [2,76,78]. Self-consciousness is a state of mind encompassing physiological and psychological attributes that enable individuals to act towards a global common good [79,80]. Therefore, individuals' top-level mental stance embraces sustainability and inclusiveness as a systems thinking perspective, thus enhancing human capacity to think and behave in a way that surmounts personal interests and addresses a common purpose to the benefit of society, the environment and humanity [81]. Moreover, self-consciousness is reciprocally related to the capacity to build personal and social identity [82].

3. A Conversational Agent in the Promotion of Healthy Ageing and Sustainable Living

3.1. The Conversational Agent

Chatbots or chatterbots are software that talks with a user by providing the correct answers to a number of questions using text and voice. They are used in various fields, such as health care, marketing, education and digital governance. Chatbots are integrated into systems that provide intelligent support to the user, including managing communication and students' scaffolding through natural language processing (NLP) and certain ontologies. Natural language processing implements algorithms and techniques, although the successful emulation of human dialogues rests both on effective conversational flows and enriched knowledge bases. Voice recognition and artificial intelligence are technologies that permit prioritisation, multicriteria decision making, problem solving, and detecting important content and interactions. Chatbots have instant availability in combination with creating easy-going interactions to elevate their engagement with the user as messaging tools and teaching assistants [83].

The current agent comprises an innovative model for personal and professional development through self-improvement methodologies and individualised training techniques. This digital tool embraces natural language processing and data mining technologies to

train its users. The tool is centred on a well-orchestrated knowledge base, preceded by a self-assessment procedure, the Cognitive and Metacognitive Skills Self-Assessment Tool. Self-assessment is a precondition for identifying a person's individual needs and interests. More specifically, the chatbot has six pillars:

- Human resources management;
- 9-Layered Model of Giftedness;
- Mental health training;
- ICTs and society;
- Brain training;
- Brain health assessment.

Based on its structure and content, the conversational agent is a behaviour-oriented, cognitive enhancement tool with training and assessment features via the Cognitive and Metacognitive Skills Self-Assessment Tool. The knowledge base forming the content of the chatbot is founded on the 9-Layered Model of Giftedness [3].

The chatbot combines brain science with education and business while it aims to train human cognition and emotions for personal and professional development in alignment with the UN Sustainable Development Goals by 2030 [84,85]. The tool is characterised by its emphasis on humans' lifelong learning as well as self-improvement in order to reach a top-level cognitive and mental state, self-consciousness [2]. Moreover, the digital tool is characterised by its human-centred and interdisciplinary perspective, thus embracing a vast research background with the aim of promoting the UN Sustainable Development Goals by 2030, especially Goal 3 (Good Health and Well-Being), Goal 4 (Quality Education) and Goal 8 (Decent Work and Economic Growth) [86–88].

This training tool proposes an innovative learning methodology in the field of self-directed learning. Also, it represents a cross-cutting look into cognitive skills training and assessment. Moreover, chatbots are user-friendly media that assimilate human conversation with multiple stimuli, thus offering intriguing interfaces and intuitive learning. Therefore, the current chatbot is a prototype, based on supervised machine learning algorithms, of an augmented intelligence chatbot to be used as a personal tutor and training assistant. Thus, the chatbot is characterised by two innovations: It represents an alternative distance learning methodology comprising personalised learning techniques and it is the precursor of an augmented intelligence chatbot in healthy ageing and sustainable living. Moreover, this tool introduces the 9-Layered Model of Giftedness as a holistic framework of personal and professional development to the international scientific community and the public [3].

3.2. Use Case Scenarios of the App

The current digital tool is developed based on an integrated approach towards personal and professional development with the aim of enhancing cognitive and mental proactive health in compliance with EU priorities about lifelong learning, social inclusion, environmental sustainability and active ageing [3].

3.2.1. Education and Lifelong Learning

The aforementioned digital tool is an initiative for delivering a non-formal adult training course under the framework of the 9-Layered Model of Giftedness for addressing personal and professional development needs and enhancing proactive cognitive and mental health strategies to the benefit of the entire community. The modules entail cognitive and metacognitive abilities and skills as well as values and self-beliefs with personal and societal impact [1]. Also, the model explains the cognitive and emotional components of intelligence and provides an integrated approach to cognitive and mental health.

The model places emphasis on self-regulation abilities, especially attentional control (selective, sustained, focused attention) as a metacognitive skill with a direct impact on human behaviour [89,90]. Therefore, the tool can be used by educators as a prototype introducing the construct of giftedness, focusing on cognitive improvement and its relation to inclusive and secure societies in the Industry 4.0 era.

On the other hand, the tool emphasises educators' cognitive abilities and self-efficacy beliefs as a means for quality education through motivating and innovative learning environments [91]. Teachers and educators need tools and methodologies for professional empowerment in order to implement inclusive strategies in schools [92,93].

3.2.2. Organisational Behaviour

As cognitive skills and personal strengths are interrelated and both depend on one's effort to improve themselves, self-improvement becomes a top priority for the state and the business sector as well as a personal goal for all people. Large organisations with numerous staff develop a very complex and dynamic scenery of relations that demands the presence of a clear-cut set of values and skills that all employees need to acquire, such as communication, cooperation, entrepreneurship, lifelong learning skills, as well as critical and creative thinking.

Moreover, employees' lifelong learning and self-leadership skills, as top-level metacognitive skills, can create a domino effect in large organisations. What is more, in order to set an example to others, it is a top priority to master one's own behaviour and corresponding cognitive status. The digital tool can be used both to introduce the 9-Layered Model of Giftedness, forming a community of knowledge and skills that addresses the need for lifelong learning in combination with active and healthy ageing, and to optimise problem solving and decision making according to quality management processes [94,95].

3.2.3. Social Dynamics

In general, mental health is innately connected to complicated mental processes, such as the ones originating from the relationship one maintains with oneself. This is the reason why intrapersonal skills are a prerequisite for other top-level metacognitive skills, such as self-regulation. Furthermore, cognitive and metacognitive skills reflect one's ability to maintain his or her health in a holistic manner, encompassing physical, cognitive and mental health components [1].

Active and healthy ageing is intrinsically related to cognitive and mental health; thus, the 9-Layered Model of Giftedness emphasises proactive cognitive and mental health through launching a digital training tool for personal and professional development. In general, the model proposes an integrated framework dedicated to EU priorities and the UN Sustainable Development Goals by 2030, embracing the core abilities, skills and values necessary for enhancing sustainability and inclusiveness in future societies and economies. Sustainability and inclusiveness are personal and social values that can also be adopted by industries in an attempt to design and produce innovative products with an emphasis on human and environmental health. Furthermore, the model aims at accelerating community dynamics and societal welfare [96–98].

4. Conceptual Sensitizing Modelling Phases

Conceptual/formal modelling is a dynamic approach, based on a literature review and analytic reflection and reflexivity on the research design. Herein lies the conceptual modelling, referring to the iterative process of design and development of the conversational agent for healthy ageing and sustainable living. All phases are iteratively repeated as collective intelligence (human and artificial) evolves, and computational and human systems converge (Table 2).

Table 2. Conceptual sensitizing modelling phases for the design and development of the conversational agent for healthy ageing and sustainable living [99–103].

Formal Design Process	
Problem Definition	• Cognitive and metacognitive skills general description. • Cognitive and metacognitive skills mapping. • Cognitive and metacognitive skills discrimination criteria. • Cognitive and metacognitive skills classification based on higher-order thinking criteria. • Cognitive and metacognitive skills classification based on implemented training techniques and tools. • Cognitive and metacognitive skills classification based on their physiological and psychological substrate processes as well as their impact on human behaviour. • Cognitive and metacognitive skills classification based on their implementation in real-life settings and multiple contexts. • Design and development of the Cognitive and Metacognitive Skills Self-Assessment Tool. • Design and Development of a training tool in the field of cognitive and metacognitive skills. • Consolidation of literature review with EU Priorities (Healthy Aging) and UN Sustainable Development Goals (Good Health and Well-Being, Quality Education, and Employability and Economic Growth) by 2030.
Methodological Approach	• Set theoretical foundations via interdisciplinary literature review in: o AI, brain science, psychology, education science, computer science, engineering and human–computer interaction. o Human–machine consciousness and brain-inspired cognitive systems. o Information systems, such as "The Open Systems Interconnection (OSI) model". • Design and development of the 9-Layered Model of Giftedness. • Development and validation of the Cognitive and Metacognitive Skills Self-Assessment Tool. • Design and development of a training tool (chatbot) with personalised features (differentiated training experience based on the score in the self-assessment tool) that aims at training user's cognitive and metacognitive skills in a hierarchical order (from cognitive to metacognitive skills) for achieving higher mental stance.
Epistemological Premises for the Research Process	The research design draws upon the designer's knowledge base. However, as research processes expand, new areas of knowledge and new aspects appear. Therefore, the research process takes into consideration the literature review to conceptualise and generate different perspectives within the research process. Therefore, research as inquiry refers to an understanding that research is iterative and depends upon asking increasingly complex or new questions whose answers develop additional questions or lines of inquiry in any field. The prototype, a chatbot, was chosen as a digital training tool in cognitive and metacognitive skills for the following reasons: chatbots are inclusive training tools as they are used in multilingual contexts via their text-to-speech (TTS) feature and their natural language processing (NLP) engine. In addition, chatbots via machine learning models offer flexible and flowing conversations as well as scalability. Moreover, chatbots may be integrated as subcomponents in an immersive online training environment based on constructivist learning methods and scaffolding techniques. Finally, dialogic systems are typical cognitive computing systems as they mimic humanlike communication and offer intuitive, user-friendly interfaces, thus raising users' satisfaction level.
Design and Development of a Training Tool (Chatbot)—Aims	The objective, scope, design and content of the chatbot are original work, with the aim of upskilling users' knowledge, skills and attitudes for personal and professional development purposes, in alignment with EU Priorities (Active and Healthy Aging) and 17 UN Sustainable Development Goals by 2030 (Goals 3, 4 and 8).

Table 2. *Cont.*

	Formal Design Process
Chatbot Structure and Properties	The chatbot has been presented in national and European peer-reviewed communication articles and follows an iterative design process as creators can improve its technical characteristics and features in real time. More specifically, the chatbot encompasses training and assessment methodologies to provide a holistic intervention framework. The self-assessment tool (Cognitive and Metacognitive Self-Assessment Tool), as a primary classification of the user's profile, gives a quantifiable result that is compared to three sets of functions that correspond to three mutually exclusive conditions (the conditions are set based on the results of the data analysis in the validation process of the self-assessment tool). Once the condition is fulfilled, the quantifiable and qualitative results are sent as "user feedback" to the user in combination with the suggested prompt for modular training. The user can take the self-assessment test multiple times or opt for autonomous training. It is worth noting that six modules are offered and there are four possible prompts; thus, based on the result, the user may be advised to take two modules. Therefore, the system is structured and forms a personalised training experience, encompassing cognitive and metacognitive skills assessment and training in a sequence. Thus, the problem definition is fully addressed via the design and development of the chatbot.
Implementation and Evaluation Parameters	• Chatbot evaluation methods (qualitative and quantitative): o From user feedback; o Automatic metrics: ■ Chatbot attributes (chatbot maturity levels); ■ Metric analysis approach. • The use cases included in Section 3.2 present the expected learning outputs and behavioural impact originating from the implementation of the chatbot and thus, from the implementation of the framework presented in the article. • Intervention studies linked to the described use cases can be conducted, and the self-assessment tool, in combination with other cognitive and emotional measurement tools, can be used for the evaluation of outcomes and results. • Evaluation of the dissemination and implementation processes regarding the framework.
Model Constraints and Limitations	The evaluation and implementation processes are susceptible to latent variables, such as personal background and opportunities given to each person during their lifetime.

5. Discussion

The 9-Layered Model of Giftedness is a holistic framework, composed of physiological and psychological components, which are dynamic and reciprocally related. In any case, active and healthy ageing in combination with sustainable living are core elements of personal and professional development in alignment with the 17 United Nations Sustainable Development Goals by 2030 [104].

More specifically, the 9-Layered Model of Giftedness is an innovative framework for supporting Goal 3, Goal 4 and Goal 8 of the UN Sustainable Development Goals by 2030, that is, Good Health and Well-Being, Quality Education, and Decent Work and Economic Growth, respectively. The model points to the critical role of lifelong learning and training in combination with self-consciousness as a state of mind for embracing sustainability and inclusiveness.

Giftedness is conceived as a set of abilities, skills and self-beliefs that form an individual's successful personal and professional life or career, through embracing sustainability and inclusiveness in their behaviour [1–4].

Therefore, there is a transversal impact on individuals' cognitive and mental health via promoting lifelong learning competences. The current study provides a holistic framework with the abilities, skills and attitudes that address the human needs and challenges of the Industry 4.0 era. In addition, the authors propose chatbot technology as an e-learning tool embracing AI technology for personalisation, scalability and interoperability. Furthermore, the current framework places special emphasis on the role of metacognition in promoting cognitive and mental capacity as well as in embracing sustainability. Therefore, sustain-

ability is a core human value of intelligence and consciousness that AI models will need to embrace in the near future.

Sustainability in computer models (computational sustainability) entails interdisciplinary research among computer science, information technology, and social, environmental and natural sciences with the aim of designing computer systems taking into account six dimensions [105,106]:

- Data centre efficiency;
- Limit and reuse of sources and materials;
- Decarbonising energy provision;
- Setting inclusive regulations and respect for human rights at the forefront;
- Setting society and the nation's welfare at the top of the decision-making processes.

Therefore, the current framework can assist in the following [107]:

- Personal and professional development;
- Improving mental health and cognitive status;
- Shedding light on EU Priorities and UN Sustainable Development Goals by 2030;
- Using natural language processing models as e-learning tools;
- Promoting sustainable AI models and applications;
- Improving brain-inspired cognitive systems;
- Holistic education reforms;
- Assessing the suitability of a proposed computational model for fostering the behaviour of a system against a list of criteria.

This review study presents an overview of the framework developed through longitudinal research conducted by the authors. The framework can be used to assist in designing sophisticated AI models by implementing interdisciplinary cognitive computing and sustainable computing research, while the Cognitive and Metacognitive Self-Assessment Tool can be used for English-speaking users as it has already been translated into the English language. In the current review, the PRISMA Abstract Checklist was used to increase the structural validity of the review [108]. However, the limitations of the study concern the small sample of the last trial in the reliability and validity procedure of the Cognitive and Metacognitive Self-Assessment Tool.

6. Conclusions

In the current study, the authors launched the Cognitive and Metacognitive Skills Self-Assessment Tool, a cognitive and mental proactive health (healthy ageing) framework and an innovative theory of giftedness (quantitative and qualitative criteria) based on non-academic-performance-oriented skills (practical, fluid intelligence). The framework and the two digital tools target personal and professional development with an emphasis on transferable skills as a prerequisite for "an integrated self" [109].

The current model aspires to have an impact on the social and economic priorities of the EU in combination with promoting the 17 United Nations Sustainable Development Goals by 2030. The 9-Layered Model of Giftedness conceives giftedness as a holistic construct, composed of abilities, skills, values and self-beliefs having an impact on the future of education and employability models. Therefore, by training individuals' cognitive, mental and physical abilities and skills in addition to raising interest in values and self-beliefs in favour of proactiveness, inclusiveness and sustainability, economic growth and social inclusion are developed in parallel [110–115]. Furthermore, inclusive and secure societies, environmental sustainability as well as healthy ageing are quality parameters of future economic development models; thus, quality education and lifelong learning become a first-class priority.

Supplementary Materials: The following are available online at https://www.mdpi.com/article/10.3390/su16072913/s1, Figure S1: PRISMA Abstract Checklist.

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