Quality 5.0 in Higher Education: A Literature Review

Ilenia Colamatteo[1], Ilenia Bravo[2], Lucio Cappelli[3]

[1]Department of Economics and Law, University of Cassino, and Southern Lazio, Via S. Angelo, Cassino, Italy, ilenia.colamatteo@unicas.it

[2] Department of Economics and Law, University of Cassino, and Southern Lazio, Via S. Angelo, Cassino, Italy, ilenia.bravo@unicas.it

[3] Department of Economics and Law, University of Cassino, and Southern Lazio, Via S. Angelo, Cassino, Italy, cappelli@unicas.it

Abstract

The world is currently undergoing a process of rapid change in all aspects of human living. The progressive digitalization of the industrial sector is promoting the creation of a sustainable Society 5.0, where humans and machines cooperate to achieve shared production goals. However, this new paradigm is still surrounded by a limited understanding and is yet to be defined, particularly regarding higher education institutions.

This paper aims to contribute to the scientific comprehension and definition of the role of Quality 5.0 in higher education institutions, by exploring how the implementation of a social-oriented quality management approach influences the university environment. A literature review was conducted to study previous papers regarding this novel topic. Using the Web of Science, Google Scholar and Scopus databases, articles were obtained based on the following string of keywords present in the abstract: (university OR “higher education” OR “higher education institution”) AND (“smart university” OR “university 4.0” OR "quality 5.0” OR “social-oriented quality” OR “society 5.0” OR quality-centric OR sustainability) considering only articles published from 2018 to 2024.

The results outline the main pillars of Quality 5.0, the potential benefits of its implementation in universities, and finally the obstacles that may be encountered in the process. The study is limited by the databases referenced and by the consideration of articles written only in English. This paper's findings can be helpful to university practitioners, managers, and other stakeholders as a guide for implementing a Quality 5.0 approach into the strategic goals of higher education institutions.

Keywords: higher education, quality management, smart university, society 5.0, sustainability, literature review

Relevant Topic: Quality Management in Service Industries

Introduction

Originating in Germany in 2011, the Industry 4.0 (I4.0) concept has connected the boundaries between the physical and the digital world. Together these two worlds have shaped the novel cyber-physical complexes that form a digital ecosystem, characterised by machine intelligence, affordable storage, pervasive computing, and robust connectivity (Salimova et al., 2020; Efimova & Briš, 2021).

As a matter of fact, these new I4.0 technologies, techniques, tools, skills, training, and education are generating new concepts, disciplines, and business opportunities such as Services 4.0, Products 4.0, Workers 4.0, and Education 4.0 (Salimbeni et al., 2023). It has led also to the inception of Quality 4.0, which is the alignment of quality management methods and tools with I4.0 principles and technologies, building and improving upon traditional quality management approaches (Barsalou, 2023; Ramezani & Jassbi, 2020). In fact, quality has been one of the critical factors for organisations to remain competitive and sustain market dominance in today's world (Huang et al., 2022).

I4.0 has also prompted the necessity to construct a Society 5.0. Although it has only been consolidated at a theoretical level by the Japanese government, Society 5.0 aims to utilise I4.0 technological developments for ameliorating the quality of life of the population by solving socio-economic issues and acting as a driving force in redefining lifestyles for the better welfare of humanity (Biswas et al., 2023). This next development of I4.0 has already begun with the recent conception of a new paradigm, known as Industry 5.0 (I5.0) (Salimbeni et al., 2023). The I5.0 paradigm represents the fifth stage of industrial production evolution, that is, a kind of people centric I4.0 where human operators work in close collaboration with smart machines with a much greater proactive emphasis on environmental sustainability. This fifth industrial revolution is predicted to generate digitised manufacturing industries with advanced product innovation capabilities, a more informed decision-making process, greater flexibility, increased productivity, and improved machine quality and efficiency (Singh et al., 2023).

Naturally, the visionary notions of Society 5.0 and Industry 5.0 require the integration of supplementary facets into the Q4.0 concept, which leads to the formation of the fifth evolution of quality management principles, known as Quality 5.0 (Q5.0). This novel theoretical concept encompasses environmental sustainability, spanned across the global landscape, by adopting a proactive stance towards continuous improvement and defect prevention. The Q5.0 paradigm plans to go beyond the limitations of traditional quality control processes, by adopting a holistic approach which focuses on social responsibility, employee engagement, sustainability, and societal satisfaction (Frick, 2023).

These fifth-generation paradigms, which will have the capacity to integrate all actors of innovative sustainable ecosystems and democratic values, have also brought about the formation of new approaches in higher education. In fact, technology and academia have been running in parallel to each other for decades to favour the continuous transformation of the higher education sector. This sector is now in dire need of an integration of innovative cyber-physical-social technologies into operational systems and processes (Alharbi, 2023). This development, which attempts to establish better quality education standards, has been attributed the name of

Education 5.0 and, in the case of higher education, University 5.0 (U5.0). A smart University 5.0 must understand and continuously improve not only its internal environment, but also the ambient external to its boundaries. The U5.0 paradigm attempts to address the present ongoing sustainable and digital transitions, with the scope of establishing a new contemporary system which systematically promotes the unfastened, "glocal", digital, and social innovations for the overall well-being of humanity and the planet (Carayannis & Morawski, 2023). Therefore, the Q5.0 concept closely ties in with the implementation of this new educational paradigm, as in order to obtain the betterment of higher education from the triplex sustainability perspective, the implementation of an adequate updated quality assurance system is a fundamental prerequisite.

The aim of this paper is to provide a possible delineation of the theoretical construct that is the Q5.0 paradigm and its potential application in higher education institutions (HEIs). A state-of-the-art literature review was undertaken to explore the main characteristics, possible benefits, and challenges of a potential implementation of the Q5.0 concept, as well as the possibility of applying it in the university environment.

Methods

A state-of-the-art literature review on the development of the Q5.0 concept and its potential role in higher education was conducted following the six-stage methodology established by Barry et al. (2022). Tab. 1 presents the review protocol utilised.

The search was carried out using Scopus, Web of Science, and Google Scholar databases. The keywords used (see Table 1) were searched based on the article abstract in the different databases. Although some experts have recommended excluding conference proceedings, this study has included them in order to extract all possible insights on this emerging research field. The references of the identified papers were also used to extend the selection process. The reviewed papers were selected according to whether they contribute to the development of the Q4.0 or Q5.0 paradigms and their application in higher education. The resulting number of papers does not include research works that were not written in the English language and all other forms of grey literature were disregarded. Papers were also excluded if they did not focus on the implementation of all three sustainability aspects in HEIs or if there was a poor research design and unclear arguments presented.

***Table 1**: Review protocol*

Item	Description
Keywords	university, higher education, higher education institution, smart university, university 4.0, quality 5.0, social-oriented quality, society 5.0, quality-centric, sustainability
Inclusion	Papers applying qualitative, quantitative methods and conceptual studies; conference proceedings; papers focusing on the development of the Q4.0/Q5.0 paradigm, quality mangement in HEIs, the implementation of TQM, Q4.0, or Q5.0 in HEIs, sustainable development goals and HEIs, integrating practices regarding the three aspects of sustainability in HEI strategic planning and quality management, digital transition in HEIs.
Exclusion	Papers not written in English; all other forms of grey literature; papers focused solely sustainability education, climate change in HEIs, environmental sustainability in HEIs.
Publishers	Springer, Taylor & Francis, Elsevier, MDPI, Wiley, IEEE, Emerald, ACM
Time Period	January 2018 to March 2024

Conceptual studies and studies implementing qualitative or knowledge-based methods that focused on broader questions were included. There were very few papers that focused on Q5.0, however, articles dealing with Q4.0, social-oriented quality, and all three aspects of sustainability, applied to the higher education sector, were considered for evaluation as many of these papers dealt with the future developments of these concepts. Two of the authors critically evaluated the studies collated based on the chosen review protocol (see Tab. 1) which was verified previously through a pilot review of ten articles in which the findings were assessed via a brief comparative analysis. This was done in order to align the interpretations of the two reviewers and account for a certain degree of subjectivity. A total of 270 papers were reviewed.

Results and Discussion

The evolution of the concept of quality

Global competition has enhanced the role of quality in the business world. In today's highly competitive market, with escalating demands of consumers for getting better products and services, the emergence of quality plays a vital role in the survival of companies. Corporate economic success, alongside the need for improvement in productivity, customer satisfaction, profitability, innovativeness, an ever-changing organisational culture, and the globalisation of world trade have also contributed to making quality a top priority for companies worldwide. In other words, these challenges and pressures have placed a renewed focus

on quality improvement which favours the company in gaining competitive advantage for the long-term survival of the organisation (Martin et al., 2020).

However, the issue lies in how to define the concept of quality, as it possesses a multi-faceted, intangible nature, thus meaning that it is subject to many different interpretations and perceptions. In fact, over time different meanings have been assigned to the notion of "quality". For example, Shewhart and Deming (1986) defined quality as an expectable degree of dependability and uniformity, as well as being at a cost convenient for the market, and Juran (1989) gave a customer-oriented feature to the concept defining it as "fitness for use". Crosby (1996) also considered quality as the "conformance to requirements or specifications" and supporting customer wants.

Before the first industrial revolution, quality was considered insignificant. However, as Industry 1.0 progressed, the importance given to quality gradually increased, leading to the development of the first quality control methods. This timeframe is referred to as Quality 1.0 (Q1.0) in the evolution of the quality concept and lasted approximately until 1890. Q1.0 revolved mainly around the inherent characteristics of a product and predominantly focused on craftsmanship, raw materials, and functionality. Back then, a high-quality item was considered as being skilfully made, functional, unique, durable, and reliable. This early interpretation of quality was quite subjective, and varied significantly based on culture, geographic area, and individual perceptions (Frick & Grudowski, 2023).

The second stage of evolution is known as Quality 2.0, which took place between 1890 and 1940, and was greatly influenced by the advent of the second industrial revolution which gave life to mass production. It marked the initiation of systematic standardisation of quality goods, gaining greater importance among both manufacturers and consumers. In this period, the meaning of quality began to mutate from being associated solely with individuality and craftsmanship to also comprehending uniformity and consistency, particularly for mass-produced products. Companies began to understand that in order to construct solid customer loyalty and remain competitive on the market, it was crucial to supply products considered of a high-quality standard. Quality control processes in factories began by focusing on defect detection and elimination, for example statistical process control, in order to favour the creation of quality goods that met a certain standard and were possible to replicate on a larger scale. Many American and European companies began establishing a special quality department, in charge of conducting quality controls just as the final task before shipping. However, they soon learned that leaving defect control to the last minute generated a lot of extra costs. The new quality improvement methods developed then, form the basis of today's modern quality management systems (Hattinger & Stylidis, 2023).

From 1940 to 1995, a significant change in the concept of quality occurred as an immediate consequence of Industry 3.0, which saw the development of new technologies, a more globalised market, and the inspiration of quality gurus such as K. Ishikawa, P. Crosby, W. E. Deming, and J. Juran. Also known as the Quality 3.0 (Q3.0) period, during this time quality was becoming an all-inclusive organisational philosophy, shifting towards a more proactive quality assurance approach with a focus on continuous process improvement. Defect

prevention was no longer just part of the final production phase but incorporated in the whole process from the very beginning. All operators were to be responsible for checking the quality output of their own work. Customer feedback grew in importance and was now considered also during the product development phases, in order to embed a high level of quality in each manufacturing stage with the aim of exceeding customer expectations. Thanks to the creation of computers and the internet, companies were capable of storing and utilising vast quantities of data to favour the improvement process. This nascent philosophy was named the Total Quality Management (TQM) approach (Frick & Grudowski, 2023; Hattinger & Stylidis, 2023).

In the era of the fourth industrial revolution (I4.0), from the beginning of the new millennium to the present day, technological and industrial advancements are currently being implemented into manufacturing procedures. These events have caused the development of the fourth generation of quality management, called Quality 4.0 (Q4.0). The Q4.0 refined approach shows a greater adaptability in dealing with these new disruptive information technologies, in catering for the demands of the supply network, and in managing and using increased quantities of data (Chiarini & Maneesh, 2022). This fourth quality revolution has a unique potential to implement automation and digitization effectively in the production ecosystem, incrementing organisation competitiveness and profitability through the enhancement of customer experience. In this sense, quality is not only about creating a product that meets basic standards; it also encompasses the consideration of the level of convenience, the after-sales services, and the overall user experience, making transparency and information accessibility fundamental in quality perception. (Antony et al., 2023).

Starting from 2020, the concept of quality is becoming ever more interlaced with innovative and sustainable business practices, constructing a holistic approach which spawned from the initiation of Industry 5.0. In fact, Quality 5.0 (Q5.0) reflects a new era marked by the completion of digital transformation, a boost in sustainability levels, augmented automation, and increased awareness regarding environmental and social issues. In this context, quality is being modernised according to the circular economy principles, which emphasise the importance of waste reduction, recycling, and reducing the environmental impact of manufacturing processes. Q5.0 is characterised by a change in model from being traditionally reactive to adopting a more proactive approach, by entrenching quality control into every phase of production with the aid of advanced technologies (Frick & Grudowski, 2023).

Principles of Quality 5.0

The Q5.0 concept is a combination of elements from Sociology, Science and Technology, all centred around the inclusive development and progress of humanity and civilization. It is a blend of social, environmental, and cultural factors, in which the idea of customer is expanded to include society as a whole. The definition of stakeholder satisfaction is broadened to include social satisfaction with a major prospect on sustainability according to which future generations are considered customers of today. Particular focus is placed on guaranteeing psychological well-being and quality work life, enhancing morale, as well as encouraging character development, empowerment, and knowledge-sharing, all in integration with technology advancements (Biswas et al., 2023; Deleryd & Fundin, 2020). The Q5.0 approach, which strives for distinctiveness and creativity, considers predominantly the human factor which has become crucial in production in terms of product/service personalization and innovation, unlike in previous revolutions. In fact, customers today are searching for unique products and services that have the personal marks of creators and craftsmen (Tadić, 2022). For these reasons, future business development strategies should not be centred only around customers and competition but must necessarily integrate social and environmental concerns as priorities (Deleryd & Fundin, 2020). In synthesis, Q5.0 is a comprehensive, proactive, end-to-end approach, leveraged by the newest technology, that guarantees high standards of quality assurance and customer satisfaction (Frick & Grudowski, 2023).

The key elements of this new paradigm include (Frick & Grudowski, 2023):

1. Design: thanks to advanced design software, companies will have the possibility to create digital prototypes on which to conduct tests in order to highlight any potential faults before constructing physical ones. In this way, the design phase undergoes a more accurate and effective quality control procedure.

2. Production & Inspection: Industry 5.0 technologies, including the Internet of Things (IoT), smart devices, automation, artificial intelligence, and robotics, can be implemented to facilitate a continuous inspection of the manufacturing process. This means that errors can be swiftly rectified in real-time, favouring a reduction in downtime and waste production, as well as making sure the product outcome complies to high quality standards.

3. Data Analysis: great amounts of data can be stored, analysed, and used throughout production, thanks to advancements in data analytics software and machine learning. Consequently, this can aid in the identification of trends or patterns of underlying quality errors.

4. Delivery: Products get delivered in perfect condition thanks to the implementation of an IoT-enabled supply chain which permits the tracking and monitoring of products in real-time.

5. Feedback: the processing and evaluation of customer feedback becomes much more efficient through the use of AI systems that have the capacity to identify emerging trends. This in turn, favours the implementation of continuous improvements in order to constantly ameliorate product quality and increase customer happiness.

These elements not only apply to the manufacturing of goods but can also be extended to the offering of services. The main processes involved in Q5.0 comprise predictive analytics, process optimization using AI, human-machine collaboration, and real-time monitoring (Arsovski, 2019). These will favour a thorough comprehension of the manufacturing and service offering processes, the prediction of potential issues, the optimization of operations, and a more collaborative decision-making process, in order to amplify product and service quality and reliability, process proficiency and customer happiness (Frick & Grudowski, 2023).

The potential of Quality 5.0

When integrated into the I5.0 framework, Q5.0 will combine the use of digital technology and automation with quality assurance while maintaining human intuition, decision-making skills, and creativity as a central focal point. It predicts and proactively addresses any maintenance and quality issues that may arise, bringing about significant advancements in product and service quality and customer happiness, while favouring waste and cost reduction (Frick, 2023). This approach enables the optimization of asset lifecycle, enhancement of operational resilience and excellence, maximisation of quality issue detection and resolution, and the promotion of an organisational culture of continuous improvement (Frick & Grudowski, 2023).

Thanks to the new advancements in technology, tedious tasks can now be completed in less time and in a more reliable and practical way. Robots can perform the time-consuming physical tasks, AI can easily collate and analyse large amounts of data, machine learning algorithms can monitor production data to identify possible quality issue patterns, human-machine communication and collaboration empowers workers and operators with the necessary knowledge and tools required to solve issues, sensors will help to avoid the manufacture of poor-quality goods, and in the meantime, people will have the opportunity to focus on more creative jobs. In fact, this will favour the realisation of ideas that could not have been imagined before (Tadić, 2022). The human factor plays a crucial role also in the resolution of issues, as people are needed to fully understand the context in order to take appropriate actions. However, an adequate organisational culture is necessary to allow continuous improvement and learning to flourish in the workplace (Frick, 2023).

The Q5.0 quality management system results in the manufacturing of superior quality products and deployment of outstanding services, which enhances process transparency, boosting customer trust and loyalty and incrementing profits. Profits are also increased through improved operational efficiency and resource utilisation, which places major importance on waste reduction and the elimination of inefficiencies. Additionally, it allows for the futureproofing of the organisation, as the Q5.0 forward-thinking style can help to avoid regulatory issues and prepare for possible shifts in consumer demand, which protect profits. The positive impacts that Q5.0 would have on the environment include placing a strong focus on sustainability and environmental stewardship, through reducing energy consumption, resource usage, etc.; reducing waste by adopting better quality control practices which means fewer defects will appear; complying with environmental regulations. Regarding employees, adopting a fifth-generation quality approach would favour employee engagement and empowerment, encouraging them to be more committed, creative, and productive

in their work. Workers and operators would have the opportunity to enhance their skill set and grow professionally, thanks to Q5.0 training. A Q5.0 inspired workplace is one that guarantees safety, diversity, inclusion, and wellness for its staff, which helps to improve the work environment and job satisfaction, attract new talented professionals, and reduce the turnover rate (Frick & Grudowski, 2023).

Furthermore, future Q5.0 professionals must possess high levels of system thinking, evidence-based decision-making ability, a continuous improvement perspective, leadership in organisational learning, as well as the ability to comprehend how decisions affect the various aspects of human lives and society (Radziwill, 2018). These professionals must acquire the skill to understand how to give products a unique touch in order to attract customer attention (Tadić, 2022).

Challenges and future prospects

Considering the new era that is at hand, sustainability has occupied a place of priority on society's agenda, thus, a fifth quality generation is expected to utilise societal satisfaction as the new way of measuring the performance of an organisation. However, the challenge here is to understand how to measure societal satisfaction, as it includes not only the economic and environmental dimensions, but also that of social responsibility. The idea of "consumer" should no longer involve only one individual or segment of the population, but incorporate social responsibility principles also, which should be of equal importance. However, for it to be attained, sustainable social development must first be outlined and accepted by all actors of the service or product supply chain (Delyryd & Fundin, 2020). For a great number of companies and institutions, this requires a drastic shift in the organisational mindset and a conversion to a forward way of thinking on how to maintain long-term survival through a combination of values that apply to a vaster number of stakeholders. This challenge has also been extended to researchers and academics of the sector, as they are faced with the issue of applying a multidisciplinary approach to quality management, by taking into consideration theories from sociology, psychology, business ethics, and change management. Furthermore, a great number of monetary resources are deemed necessary to favour an efficient and effective transition to the new Q5.0 paradigm in all sectors (Arsovski, 2023).

As it is a complex mission to complete, for an organisation to make this transition happen, the design and development of an action plan is fundamental. It is also important to remain consistent to the plan as much as possible and to have full participation on behalf of the staff. To favour participation all aspects of the plan must be explained in detail in terms of why and how the tasks will be undertaken. Management must keep a close eye on employees that tend to not be open to change or that may create discontent among the staff group. This kind of behaviour is quite often due to a lack of understanding of the new approach being implemented, fear of what may be deemed as unknown, or even fear of losing their job. These issues must be dealt with as soon as possible, otherwise other employees may begin to lose faith in the plan, sabotaging the success of its development. Even if managers know all about the implementation of Q5.0, if they are not capable of passing

this knowledge on to their colleagues, motivating them into action, and establishing a spirit of togetherness, the chance of a positive outcome will be quite scarce (Tadić, 2022).

Another challenge that is presented is the acquisition of the ability to handle modern technologies, as I4.0 technologies will be upgraded and continued to be used even throughout I5.0. Hence, it is essential for all types of organisations to adapt and apply these new tools in their daily operational processes, as quality performance strictly depends on this adaptation. In fact, the key to success for any organisation lies in the upgrade of existing technological assets and the acquisition of other modern advancements (Frick & Grudowski, 2023).

Furthermore, the role of quality professionals must be modernised to include competencies that will be of greater assistance to the requirements of current stakeholders, in order to achieve greater societal satisfaction. Thus, Q5.0 professionals must possess the following characteristics: flexibility, courage, passion and drive for change, and creativity to allow for the organisation to reach its full potential. On top of this, management teams must assume the role of co-producers and collaborators of the business development, alongside consumers and stakeholders. Consequently, this leads to the necessity of developing new management models that favour the adaptation to a market environment in continuous evolution. These models must promote awareness of the current technological advancements, an inclination towards new business habits, and encourage employees to embrace change. This is critical for the successful introduction of the Q5.0 approach (Delyryd & Fundin, 2020). Other potential challenges that may arise during the implementation process include concerns regarding data management and privacy issues, and the risk of technology dependence arising.

The potential role of Quality 5.0 in the higher education sector

Despite there being little or no evidence in current literature of a potential implementation of a Q5.0 paradigm in the university environment, there has been much talk of incorporating various principles in strategic processes, which are directly linked to this novel paradigm.

Having committed to the contribution and development of education, research and cooperation with the societal environment, HEIs have been faced with drastic changes in society. They must rapidly adapt to these revolutions by initiating a transformation of the institutional organisation and internal environment. This renovation of the higher education sector is, in fact, part of the fifth-generation revolutions and is beginning to be associated to the terms „University 5.0"(U5.0) and „smart university". The effective realization of these so-called „smart universities" is predicted to commence by the 2030s. HEIs must undertake a radical transition to the U5.0 paradigm in order to provide future graduates with the adequate skills and knowledge for which the fourth and fifth industrial revolutions have created a necessity. In today's world, technological innovations have favoured the spread of the digital transformation to all parts of everyday life. With these, new challenges have arisen which cannot be simply resolved by adopting a unilateral approach. These complex challenges require universities to employ innovative, open, and socially inclusive approaches. They must aim to go beyond their traditional operations and begin assuming a proactive role in transformative change and in generating real social impact. In fact, one of the key roles of U5.0 is to form qualified human resources that will contribute proactively and through innovative ways to this positive digital transformation and change of the societal ambient (Akturk et al., 2022; Andres et al., 2022). It can be noted that, proactivity and continuous improvement are two characteristics of the U5.0 approach, which are also common to the Q5.0 approach, thus creating another linkage between these two innovative concepts.

The achievement of a high quality third-level education is the basis of sustainable development from all aspects. As part of the U5.0 approach, HEIs must necessarily instil a balance between environmental, societal, and economic sustainability in order to navigate successfully through uncertain geopolitical times and complete digitization. These institutions have the fundamental role of being society's developers and advocates of new knowledge. Thus, the future development of society depends upon the quality of education received by current and future graduates. Additionally, the implementation and improvement of processes which guarantee higher educational quality will support future citizens and favour social development. A sustainable HEI can be defined as one that nurtures a high quality of teaching, carries out processes that ameliorate academic quality of life, and optimizes its consumption of natural resources. By combining digital technological tools with sustainability concepts, academic professors will have the opportunity to enrich the student learning experience. Furthermore, educating students in sustainable development is fundamental for the instauration of a Society 5.0 and for the accomplishment of the UN's sustainable development goals. (Olmos-Goméz et al., 2020; Islam & Khan, 2023). This pursual, on behalf of HEIs, of sustainability in its various forms is in fact one of the focal points of the Q5.0 paradigm.

The U5.0 paradigm also comprehends the continuous cooperation between the following five dimensions: industry, government, university, society, and the natural environment. Experts define it as an innovative, „evergetical", eco-system, with a human-centric approach, in which institutions can collaborate in the creation and divulgation of information, necessary for the development of innovative change. To safeguard this eco-system of innovation, distinct vision and mission statements must be established and, subsequently, incorporated into the HEI's organisational strategy, while considering all legal, social, and ethical aspects that may be implied. Universities must be capable of comprehending what competencies their graduates require and align their teaching and assessment operations in order to place students at the centre of education. Studies have shown that allowing students to create and govern their own personalised learning paths, suiting their individual needs, aspirations and creativity, favours the betterment of their academic performance and success. In fact, by implementing the digital U5.0 approach students take on a more central, proactive and independent role, while teachers and lecturers act as mediators and facilitators of this process. This leaves educators with the responsibility of developing adequate curriculums which rotate around digital skills, green literacy, cognitive and metacognitive abilities, social and emotional skills, as well as practical and physical skills which incorporate the new communication technologies (Eskinat & Teker, 2023; Vieira et al., 2023). These elements of cooperation, inclusivity, and human-centricity are shared principles central to both the U5.0 and Q5.0 approaches.

Conclusions

In this article a state-of-the-art literature review on the potential role of Quality 5.0 in HEIs was conducted, offering an overview of its main characteristics, principles, the potential benefits of its implementation, any possible challenges that may be encountered, and how this approach could be applied in the university environment.

Quality 5.0 is a relatively new theoretical approach which has attracted much attention from academics, as shown by the increase in the number of papers published in the last few years. The literature review exposed various aspects related to Q5.0. Firstly, the concept of quality has undergone various evolutionary stages over time, with the fourth generation of quality being currently in action. In order to favour the transition from Q4.0 to Q5.0, many changes are necessary, thus it is fundamental to comprehend all aspects of this new approach. Q5.0 can be defined as a proactive quality management approach that leverages advanced technologies in order to increase manufacturing efficiency, elevate the quality standards of goods and services, and exceed customer expectations. It places the human being at the centre of the paradigm and the aim is to not only obtain economic sustainability, but also give priority to environmental and social sustainability. In fact, a sustainable organisation must adopt an inward- and outward-mindset in terms of innovation, in order to survive in a fast-changing world. Q5.0 principal values must be internalised in companies and institutions, in order to shift from a consumer satisfaction perspective to a societal satisfaction perspective.

Despite the potential of Q5.0, its future remains uncertain as there are many challenges to overcome and issues to resolve regarding the effectiveness of the implementation process. The main difficulty is that of encouraging society as a whole and organisations to adopt an open mindset that is focused on sustainability and that welcomes change. Implementing this new paradigm would require redefining the organisation's culture, values, mission, and production processes or service offering in order to incorporate environmental stewardship and social responsibility principles. However, these issues could be an opportunity for the academic community to conduct further research and investigations, in order to favour the realisation of Q5.0 at its full potential not only in industry but also in higher education.

The findings of the review highlight many gaps in the literature regarding realistic implementation of the approach and concrete developments of the actual advantages and disadvantages of its adoption in the higher education sector. However, there are many hey elements of the Q5.0 approach that have been considered individually and analysed. In fact, fundamental principles, including proactive approach, continuous improvement, the various aspects of sustainability, external cooperation, inclusivity and human-centricity, have been studied in great detail and attributed to the innovative concept of U5.0. Despite not having been associated directly to Q5.0, it is obvious from the literature review that the principles of U5.0 are strictly tied to those of the fifth generation of quality.

The study is limited by the lack of quantitative data and case studies currently present in the literature, by the databases referred to, and finally by the consultation of papers written only in the English language. Hence, future research is required in order to develop quantitative and practical evidence of the successful application of Q5.0 in the higher education sector and its influence on the overall performance of HEIs. For the time being, the Q5.0 paradigm remains merely a theoretical conception in need of further development.

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