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Article

Characterization of the teaching profile within the framework of Education 4.0

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Abstract: Education 4.0 postulates the flexible combining of digital literacy, critical thinking, and problem-solving in training environments linked to real-world scenarios. Therefore, teachers are challenged to find or develop new methods and resources to integrate into their curricula to help students develop these desirable and necessary skills; hence, the question: What are the characteristics of a teacher to consider within the framework of Education 4.0? This article presents a study carried out in a higher education institution in Ecuador. The objective was to identify the teaching profile required in new careers within the framework of Education 4.0. The descriptive, exploratory methodology applied quantitative and qualitative instruments (surveys) to 337 undergraduate students in education careers and 313 graduates. It also included interviews with 20 experts in the educational field and five focus groups with 32 rectors, school principals, university professors and specialists in the educational area. The data was triangulated, and the results were categorized in (a) processes as facilitators (b), soft skills, (c) human sense and (d) use of technologies. This article may be of value to administrators, educational and social entrepreneurs, trainers, and decision-makers interested in implementing innovative training programs.

Keywords: Teaching profile; Educational Innovation, Higher Education, Entrepreneurship, Ecuador, Education 4.0

1. Introduction

New roles in sectors such as industry, society, government, and education have emerged due to the dizzying pace of technological development in recent years. The teacher must become a change agent and transform his or her knowledge, skills, and competencies. Hernandez-de-Menendez et al.

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[1] analyze these changes as necessary because of the Generation Z students, seen as true digital natives. They are a hyper-cognitive generation with student profiles different from the previous ones, requiring new forms of teaching and learning from teachers experienced with emerging technologies. In turn, the mediation of technologies causes changes in teachers' roles; therefore, educators need to be open to continuous improvements in instructional practices [2]. There is a need to develop ways to equalize the positions between the instructor and students, while the professors need to be aware and provide opportunities for students to demonstrate creativity in their work. Influenced by external changes, the teaching role changes internally.

In all these changes, the theme of digital literacy is constant. Developing digital competencies will help with better time management, greater confidence, development of socio-constructive attitude [3], increased student productivity, time savings for instructors, and better test results, among other things [4]. Technology-based learning experiences promote students' creative design competencies, positively impacting students' educational performance and skills development [5]. Creative designing also requires the right infrastructure with innovative learning spaces, which are thought to respond to future changes and students' needs and learning methods [6]. In this framework, digital literacy competencies linked to teacher training are delineated to improve educational quality.

Various research works agree that the teacher is the single most crucial factor determining the quality and effectiveness of education. Serdyukov [7] states that it is necessary to improve teacher training and lifelong learning. To achieve this goal, the teachers must have good attitudes and dispositions. Their environment must support developing their teaching styles, motivation, skills, competencies, self-evaluation, self-efficacy, creativity, responsibility, autonomy to teach, ability to innovate, absence of administrative pressures, better working conditions and supportive public policies. Teaching roles change significantly when the environments are mediated by technology, so educators need to be open to continuous improvements in instructional practices.

How is the teacher's role linked to the possibilities of educational innovation? One scenario involves the implementation of instructional strategies to create innovation in learning. Seechaliao [8] determined that the teacher should use questioning, classroom discussion, self-directed study, inductive and deductive thinking, and social media and networks that engage students in learning activities. Similarly, in modern educational systems supported by technologies, educators must take the following factors seriously: the role of learners, new ways of constructing knowledge, the real possibility of continuous assessment, and direct and interactive communication with the community [9]. Other authors [10] concluded that support should be provided for formal and informal education so that frequent opportunities for joint planning and teaching can occur. Creating innovation requires the teacher to bring together three fundamental aspects: a brilliant idea, a macro-environment comprised of the educational environment and society, and a micro-environment that enables innovation [7].

In particular, teachers should plan the learning activities to take place over an extended period so that students have time to develop and refine their work. Emphasis needs to be placed on

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providing a high-quality Information and Communication Technology (ICT) infrastructure and ongoing support; its absence would be a potentially significant barrier to innovative teaching practices. This is the case of hybrid learning, defined as combining different instructional methods, pedagogical approaches, and technologies to enhance teaching and learning [11]. Hybrid-synchronous-learning designs result in more active learning than traditional classes [12]; however, the main problems faced in facilitating these types of lessons are related to communication and cognitive overload caused by dividing attention. The "intelligent learning environment" allows the teacher to adapt to different educational environments through knowledge, task support, learner sensitivity, context-sensitivity, reflection, and feedback [13]. The notion of environment encompasses its design and development, how the learner is engaged, and to what extent the environment is effective and efficient. Its success is measured by the freedom of activities and stimulation of ideas and results from the teacher's attitude to promote innovative ideas [14].

Technologies bring teachers together to generate active learning spaces in the formative environments of Education 4.0. Education 4.0 is based on learning by doing, in which students are encouraged to learn and discover in unique ways through experimentation [15]. Miranda et al. [16] define Education 4.0 as the current period in which higher education institutions apply new learning methods, innovative didactic and management tools, and intelligent and sustainable infrastructures complemented by emerging technologies that improve the processes of knowledge generation and information transfer. Also, they propose four central components of Education 4.0 to be used as a reference for the design of new educational innovation projects: (i) Competencies, (ii) Learning Methods, (iii) Information and Communication Technologies, and (iv) Infrastructure. A 4.0 teacher must have the same competencies demanded of students: digital literacy, critical thinking, and problem-solving, which is of great interest to employers, who are the main stakeholders in education [17]. Prieto et al. [18] outlined an Industry 4.0 Technologies Laboratory (I4Tech Lab), a technological environment for academic research and industrial promotion of related technologies, supported by an active-learning teaching methodology. Another possibility is to use augmented reality in a modular learning system with an interactive virtual model of the equipment, technical data, and information processed in real-time [19]. For his part, Caluza [20] states that Education 4.0 encourages using advanced technologies to facilitate the educational ecosystems, in which teachers must be proficient in information and communication technologies. In the same vein, the dynamic nature of the higher education ecosystem and the connectivity between the elements of Education 4.0 are highlighted: knowledge, industry, and humanity [21].

How prepared are teachers for Education 4.0? Goh & Abdul-Wahab [22] argue that current faculty may lack the pedagogy needed to teach in this "digitalized" world and are not competent to guide students into the new era of technology-driven experiences. They assert that institutions need to move away from the traditional way of delivering knowledge and conducting research to adopt new ways that provide autonomy to educators to define goals in the formative process where students learn through technology [23], and the approach is learner-centered [24, 25]. The teacher competencies required to perform in these environments must be identified [26]. Teaching and

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learning processes, innovation, and value-added experiences for students using technology are part of the concept of Higher Education 4.0.

This article aims to characterize the teaching profile in the framework of Education 4.0 through a descriptive exploratory study in a higher education institution in Ecuador. The exploratory method is presented by applying quantitative and qualitative instruments to undergraduate students in education curricula, graduates, teachers, and experts in the educational field. The results are presented, and the data with triangulated sources and instruments are discussed. The article ends with some conclusions that enunciate crucial Education 4.0 teacher characterizations and delineates its limitations and contributions for considering future studies.

Materials and Methods

The purpose of this paper is to describe the teaching profile for Education 4.0. The starting point was the question: What are the characteristics of the teaching role for Education 4.0? To answer this question, we used four instruments to collect data from students, graduates, teachers, and experts. The units of analysis were the current teachers' profile, the profile of the students in education careers, competencies required of the teacher, and characteristics of an innovative teacher.

Based on the objective and the research question, we chose a descriptive exploratory method with a quantitative approach characterized by describing, analyzing, and interpreting complex phenomena from a social perspective [27]. The qualitative approach analyzed data without numerical measurements, using descriptors and observations, attitudes, thoughts and motivations [28]. For the collection of the information, we conducted: a) surveys, b) interviews and c) focus groups.

The surveys' target population was undergraduate students and graduates in education curricula. We used databases provided by the university of this research and secondary databases. To define the sample, we applied a formula and weighting for finite universes. A total of 337 current students and 313 alumni were surveyed. A diagnostic instrument from a Mexican university [29] was adapted to the Ecuadorian context. Before its application, the instrument underwent a validation process by experts.

The survey consisted of 31 structured questions that explored the units of analysis of the current teacher's profile, the profile of the student in education careers, the competencies required of the teacher, and the characteristics of an innovative teacher. The survey was administered using SurveyMonkey. The questionnaires were sent through e-mails and telephone calls. The results were presented in Excel and SPSS (v.22.0) format for analyses. Also, there were 20 in-depth interviews conducted with experts in education from Mexico, Spain, Colombia, and Ecuador. NVivo11 software was used for data analysis of these interviews.

The focus groups yielded units-of-analysis data on the current teacher profile, teachers' competencies, and innovative teachers' characteristics. There were four focus group sessions with 32 people, including educators, rectors, school principals, university professors and specialists in the educational area. NVivo11 software was used to analyze the information.

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The application of quantitative and qualitative instruments made it possible to have greater validity in the results. The triangulation analysis of the data came from three actors: students, graduates, and expert teachers and managers in education. This analysis made it possible to clarify and complement the information collected, considering the different stakeholders' perspectives [30]. Ethical aspects were taken care of in the data collected through permissions to use the information for academic purposes. The data management was handled objectively to provide valid evidence. Finally, the privacy of the participants' data adhered to the institutional policies involved in the study.

3. Results

The results derived from the units-of-analysis data are presented below.

3.1 Current teacher profile

According to the people consulted in the focus groups and interviews, the existing teacher profile does not meet current contextual needs. In the sense that the teacher's profile should lead to achieving educational objectives and future generations' training, the people who participated in the focus groups determined a series of teacher training deficiencies. From the transcripts of the different sessions that took place, the following reflections emerged:

The classes were still lecture-based, so an urgent change was required in the pedagogical processes carried out for education careers. For example, a comment in one of the groups was, " *The teacher needs to master constructivism. The Universities are familiar with this methodology, but a little more is needed for development. Time and experience mold the training, and the teachers must investigate to ensure that their students get the skills they need*."

Another of the problems detected is the lack of knowledge in the use of technology. Thus, the groups commented that "*the pandemic revealed how unprepared the education careers were using new technologies for teaching purposes*." Another group mentioned that "*both students and teachers are unfamiliar with tools that facilitate learning in completely virtual environments*."

The participants felt there is a lack of appreciation for teachers' work and that those who enter this profession do not do so out of vocation but because of a lack of job opportunities in other areas. One of the groups indicated that "*the teacher feels undervalued, burdened with administrative work, pressured by peers, with a low social valuation of the work*."

Also, they mentioned the absence of creative or divergent thinking and the presence of reading problems. They commented, "*The teachers have low reading levels, i.e., an initial reading comprehension level," and "very little ability for divergent thinking, understanding education as transmitting knowledge and not as sharing and spreading what they are passionate about*." Finally, there is a problem with the teaching practice, as commented in one of the groups: "*Direct interrelationships are required in the field. The practices and the monitoring of practices by the authorities of the institution where they are carried out should be improved*".

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These reflections also agree with the experts' responses to the interviews. They mentioned that "*education careers are perceived as outdated and focused on the repetition of knowledge and memorization*." In addition, there is little connection between theory and practice, nor is there a connection to the realities experienced by teachers.

The experts also commented that due to the pandemic, the lack of preparation of teachers and students to work in virtual environments was evident and "*Careers in education are perceived as rigid and based on the 'should be;' so curricular adaptations cannot be made*."

3.2. Student profile in education careers

To determine the current student profile in education careers, we analyzed the survey results for current students at the Ecuadorian university (object of study) and the survey for graduates of the same university. These results showed that current students' age in education careers was 19 to 40 years, with the highest percentage between 19 and 25. The graduates were between 25 and 45, with the highest occurrence between 32 and 38. In both groups, the majority were women, and most of them graduated or were studying Primary Education, as shown in Table 1.

Table 1. Participants' characteristics

Participants	Age	%	Gender	%	Career they study	%	Occupation	%
Current students	19-25 yrs old		Female		Primary Education		Students	52.8
							Workers	33.5
	26-33 yrs old		Male		Primary Education		Unemployed	11.9
	34-40 yrs old				Science pedagogy		Other activities	1.8
Former students	25-31 yrs old		Female		Primary Education		Workers	
			Male				Unemployed	
	32-38 yrs old				Educational sciences		They work and study	
	39-45 yrs old				Infant education			

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Almost half of the current students were working in the public or private sector. In the case of graduates, the majority worked in private companies and educational institutions. The salary difference between students and those who have completed their studies was 60% more for the latter.

The characteristics of the careers most sought by students were teaching quality, certifications, scholarships, modality, price, and offering of undergraduate programs, as shown in Figure 1. Also, they mentioned flexibility, technology, and administrative attention as attractive elements for choosing an academic discipline.

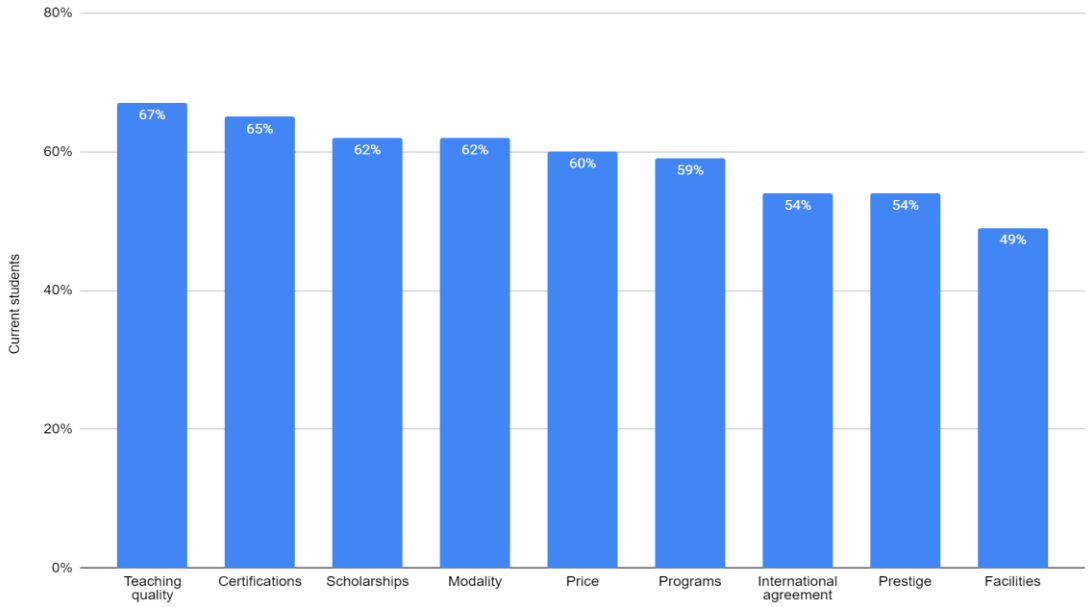

Figure 1. Characteristics of the most requested academic programs by current students

In terms of teaching modalities, current students require that the virtual modality have adequate synchronous sessions and be flexible to facilitate their work and personal life and allow them to interact sufficiently with teachers and classmates. For education graduates, their interest in continuing with a career would be in the distance mode because it enables them to continue their work and personal life. The characteristics they desire are adequate synchronous sessions, excellent teaching and learning strategies, and sufficient interaction with teachers and classmates, as shown in Figure 2.

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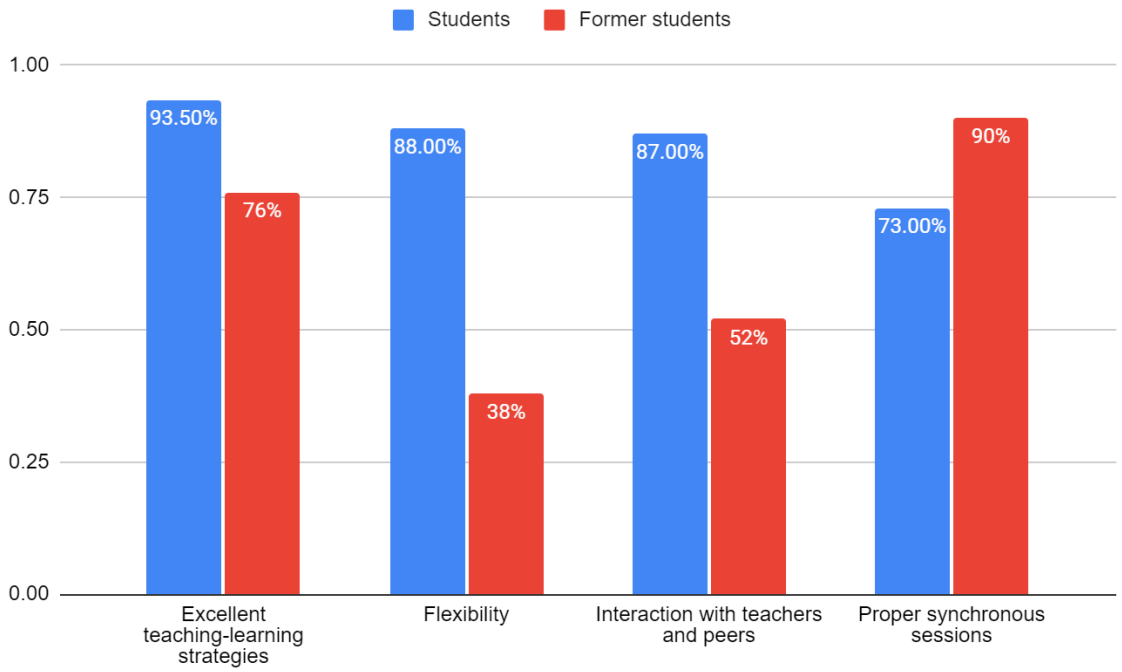

Figure 2. Characteristics of the online careers

The choice stated by the graduates to study a career in education is based on their vocation, family opinions, and the earning potential of their profession. Also, respondents believed that education careers should include digital transformation (80.2%), reasoning for complexity (78.3%), ethical and citizen engagement (78%), social intelligence (75.1%), self-management skills (73.5%), inclusion and respect for diversity (70.9%), social responsibility (65.5%), and innovative entrepreneurship (45.4%)(see Figure 3).

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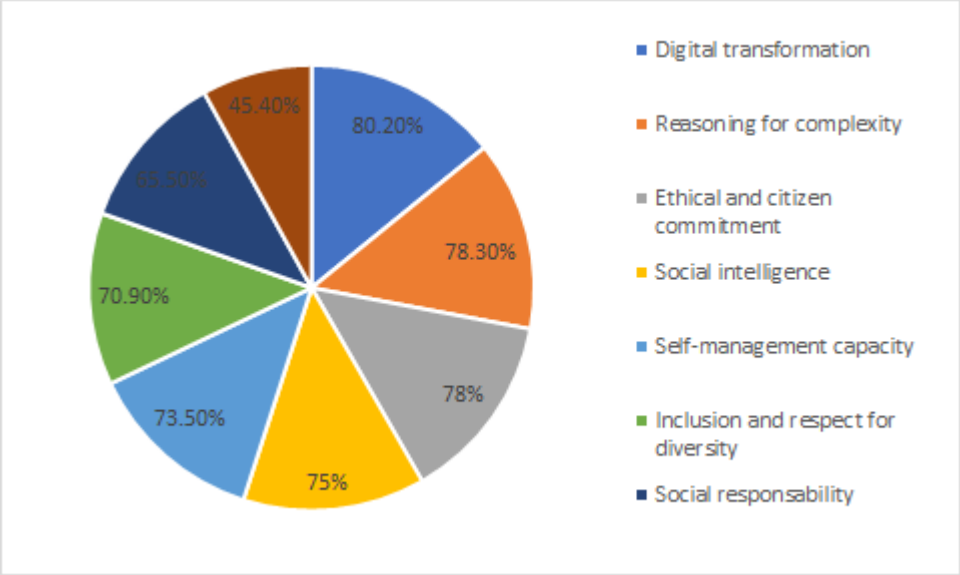

Figure 3. Students'interests.

According to the graduates' responses, at the end of their degree, 250 people indicated that they would like to study for a master's degree; 49 people would like to study for another degree, and 43 would like to study a specialty. In education, they mentioned an interest in continuing with primary education, university management, and educational management.

3.3. Competencies required of the teacher

According to the interviewees, the ideal teacher profile for Education 4.0 should maintain a balance between soft skills such as leadership, motivation, and communication and technological competencies and critical thinking. As one of the interviewees mentioned, "*The teacher must have a strong leadership profile and be focused on the students' needs. They must exert pedagogical leadership, being a leader who motivates and generates concerns, have mastery of ICT with an overall view of the global culture, and be involved in the globality of thought*." Another interviewee commented, "*In the technological field, teachers require the necessary competencies for digital pedagogy."*

Regarding soft competencies, such as communication, it was mentioned that "*Educators should be experts in communication, in written elements and interpersonal communications, competencies of the teacher of the 21st century*". They also mentioned having competencies to work not only by objectives but also by carrying out formative actions: "*How do we want them to apply this knowledge*? H*ow do we want them to put it in a real practical context?*" These questions lead teachers to curricular design that counteracts a repetitive education that is based on memorization and oriented more to practice and problem-solving.

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The teacher of the future should be critical and have a greater capacity for analysis. As one of the experts mentioned, "*The profile should be that of a research teacher, one able to diagnose the problems of his or her context and propose various solution projects*." It also requires a much more human, empathetic teacher, who becomes a facilitator and a coach for students, as mentioned by the experts: "*The teacher must have didactic competencies and humanistic, relational competencies;*" "*the teacher must be a guide, a facilitator, the one who supports, who guides, who follows, who leads, and who facilitates their students' learning*," and "*assumes the role of a coach and designer of learning experiences, not a repeater, nor a transmitter*."

3.4. Characteristics of an innovative teacher

According to the experts, the profile of the teacher must be adjusted to meet the new requirements. In this sense, universities must train professionals in education with different competencies and skills and prepare them for a role that differs from the traditional teacher. There must be a balance between soft skills and technological competencies. For example, one of the experts commented that "*the graduate in education must have a good handle on managing information through technologies*" and "*training new professionals who understand the society we live in.*"

Among the competencies mentioned were problem-solving, developing playful and practical activities, creativity, research, accompaniment and training, and skills with distance learning devices. Also mentioned were critical and creative thinking, research, innovative entrepreneurship, knowledge of the subject, organization, human sense, empathy, ability to evaluate, self-management, ethical and citizen commitment, digital transformation, social intelligence, and innovation.

Other comments from the experts were, "*A deeply humanistic person is needed, one who has an elaborated and developed critical thinking and is aware of the main problems of society*." Another expert mentioned, "*The teacher must be a person who has a collaborative spirit, who can share his knowledge, who can unlearn to learn again, and who can work on a team with teachers and managers to transfer this knowledge to his students, and be the example to which the students aspire.*" The teacher *"not only imparts knowledge but also generates or ignites their interest; the teacher is more of a facilitator of learning."*

The teacher's role is no longer one who only shares knowledge. They are facilitators who promote reflection and bring that knowledge closer to the students' reality. The experts commented, "*So, the teacher of the 21st century is a facilitator, a collaborator, a digitally competent person, one who works in a team and learns continuously. The last one is crucial. The teacher must be a person who is continuously researching, learning, and applying and experimenting in their classes.*"

The teacher must also master other languages and know new technologies like artificial intelligence and digital technologies with educational applications. They must promote critical thinking, design study plans that generate learning for the students' reality, and develop projects that impact different community sectors. The characteristics of the teacher profile are presented in Figure 4.

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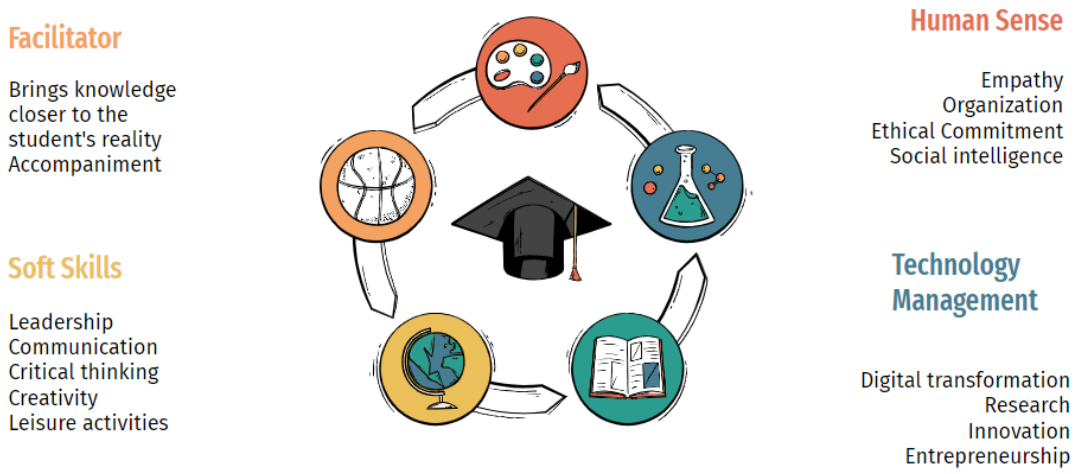

Figure 4. Teacher's profile to meet the new requirements.

4. Discussion

Teachers play a crucial role in current education, especially for the future professionals of educational sciences, because they will be the next educators. Teachers are responsible for the transformation of the students' learning model. According to the results, the profile of the current teacher has characteristics of a traditional teaching model. Hernandez et al. [24] state that current students of education have not integrated the theoretical and practical knowledge required to perform their roles at the end of their training. Many cannot design and implement programs for pedagogical intervention with a student-centered teaching approach in which profound learning is developed. The experts interviewed agree with Alsina [25] that the universities must guarantee that future teachers develop self-regulation during their training process, have elements to mark their behavior, assume goals, design strategies to achieve them, and self-evaluate the results critically and objectively. The teaching profile is postulated as a substantial element for the formation of students in these new scenarios.

Education 4.0 students apply for training programs and accreditations that certify competencies, supported by consolidated academic, technological, and administrative aspects. Figure 1 shows the characteristics of the careers most sought after by students, where teaching quality, certifications, scholarships, flexibility, technological aspects, and administrative support are valued as attractive elements for choosing a career. Miranda et al. [16] agree with the pillars of Education 4.0, such as training by competencies, active learning methods, information and communication technologies and infrastructure, all components necessary for designing new educational innovation projects. The curricular design faces the challenge of consolidating students' expectations with the university supports available to the teachers.

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Designing flexible environments to solve real problems is one of the challenges of strengthening Education 4.0. Figure 2 shows that both current education students and graduates require the virtual modality to be flexible to facilitate the continuation of their work and personal lives and allow them to interact sufficiently with teachers and classmates through adequate synchronous sessions. Also, the lack of valuing the teaching career is a result that concerns the population in the analyzed sample. Making this profession attractive and valuing teachers' responsibility and social commitment are pending tasks for governments and universities. Accomplishing this should improve the selection choices of those entering this career [26]. Linkage to the real world and course flexibility are elements to consider when designing education curricula that accommodate digital transformation.

This digital transformation requires a commitment to change and innovation from academic actors in Education 4.0 environments. As Figure 3 shows, the student profile of the teaching discipline must integrate competencies related to digital transformation, the reasoning for complexity, ethical and citizen commitment, social intelligence, capacity for self-management, inclusion and respect for diversity, social responsibility, and innovative entrepreneurship. These competencies are also required in an Education 4.0 model [16], which incorporates innovative learning methods, didactic, pedagogical, social, and technological competencies, and others. The transversal training to develop digital skills in students should be an essential point in training programs.

The teacher profile in Education 4.0 requires disciplinary and transversal competencies, where digital competencies are also a constant, as with students. According to this investigation's results, the ideal teacher profile for Education 4.0 should have both technological competencies and soft skills. Other authors, such as Carvalho et al. [3], coincide; they indicate the need to develop digital literacy in teachers to favor educational quality. This is because implementing technology-based educational experiences can positively impact student outcomes [5], provided that it is accompanied by teacher training that allows the development of other skills such as motivation, self-efficacy, responsibility, and the ability to innovate [7]. These are competencies required for the teacher to assume a role as a facilitator of student learning where the student participates actively in their training.

The competencies required in a teacher for the new scenarios are related to innovation, problem-solving, creativity, critical thinking, research, and entrepreneurship. The results in Figure 4 show what is desirable in the profile of teachers. The teacher must promote these in his/her students, as mentioned by Peredrienko et al. [17]. These attitudes will be of great value for the student to integrate into the labor market in a context that requires knowledge for an increasingly digitalized world. In the consultations with the experts, we determined that education must stop being traditional and relying on memorization, elements that stifle the development of creativity and innovation; it must favor entrepreneurship and research. In this sense, institutions should develop pedagogies that encourage these processes and allow teachers to guide students towards creating experiences facilitated by technologies [22]. Hence, a teacher leadership profile is proposed to promote digital pedagogies in the context of the current reality.

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The knowledge that the future teacher must have about their role is a determining element to achieve success in students' education. In turn, universities must train professionals prepared for Education 4.0. This study recognizes that teachers must have a human feeling, ethical commitment, and social intelligence and have the necessary technological and soft skills. This finding is supported by research by Serdyukov [7], where the teacher must integrate the different environments of education and society, creating a suitable atmosphere to develop competencies in the student. Also, as supported by other research, intelligent learning environments that allow students to adapt to changes, offer opportunities for reflection, and be attentive to their sensitivity should be fostered [13]. It is considered that these characteristics of the teacher will allow the generation of spaces that enhance innovative ideas, are sensitive to the environment and take advantage of technologies to benefit citizens' training.

5. Conclusions

The study presented was based on an exploratory, descriptive analysis where students, graduates, teachers, experts, and decision-makers (rectors, school principals, university professors and specialists in the educational field) were consulted to answer the question: What are the characteristics of a teacher in the context of Education 4.0?

The data analyses show that an Education 4.0 teacher (a) designs strategies for competency-based training through active learning methods, (b) has soft skills, such as digital transformation competencies, the reasoning for complexity, ethical and citizen commitment, social intelligence, capacity for self-management, inclusion and respect for diversity, social responsibility, and innovative entrepreneurship, (c) has human sensitivity and trains students to develop ethical behavior and social intelligence, integrating the educational environment and society, and (d) uses technologies and applies new tools that facilitate learning through virtuality, artificial intelligence, digital technologies, and educational applications.

Although this study focused on teachers' profile for careers related to education, the findings may be of value for the characterization of teachers in other disciplines, in the sense that they are also trainers of talent. This study may also be of value to administrators, educational and social entrepreneurs, trainers, and decision-makers interested in innovative training programs.

Future research can be oriented towards strengthening the teaching profile for Education 4.0, taking the findings of this research in university curricula to explore ways to integrate other educational community members, industry, and social actors to develop innovation competencies.

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