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Analysis Of Collective Intelligence in The Education of University Students

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Abstract

The objective of this research is to recognize how teamwork, collaboration, and communication can enhance students' learning and skill acquisition. An extensive search will be conducted on collective intelligence, its tools, and how it supports collaborative learning in higher education. Surveys and interviews will be conducted with university students to gather information about their experiences and perceptions regarding teamwork and collaboration. The data analysis will determine the importance of collective intelligence in the education of university students. It will also identify the tools that allow us to develop collective intelligence to foster collaboration and teamwork, as well as to identify and design strategies to improve implementation methods in higher education and student development. The results of this research could be used to develop specific training programs for university students and to provide resources and tools that support the development of collective intelligence. Furthermore, collaboration networks could be created among students, teachers, and other members of the university community to promote knowledge exchange and innovation, there by improving academic training for their professional and personal development.

Keywords: *Teamwork, collaboration, communication, academic learning.*

Introduction

Collective intelligence is the intellectual capacity that emerges from the collaboration of several individuals or a community to address a common problem. In recent years, there has been a growing interest in implementing collective intelligence methods and tools in the education of university students. This is largely due to the need to prepare students to face the challenges of an increasingly complex and interconnected world, where collaboration and teamwork are essential for success.

However, there are significant challenges to consider when implementing collective intelligence methods and tools, as it can be difficult to ensure cooperation among all group members. It is also essential to guarantee that all students possess the necessary skills to contribute effectively and that group objectives align with the learning goals of the course.

Despite these challenges, the implementation of collective intelligence methods and tools is becoming increasingly important in higher education. Over time, this practice is expected to become fundamental in the training of university students, enabling them to develop skills and prepare to face the challenges of the modern world more effectively.

Problem Statement and Justification

Collective intelligence can be broadly defined as the capacity of a group to think, learn, and create jointly. Aulinger and Miller (2014) describe it as a degree of skills among two or more living beings to overcome challenges by aggregating individually processed information, following shared rules on how to participate in the collective. This conception highlights the importance of promoting collective intelligence in university education, where collaboration and shared learning are essential to tackling contemporary challenges.

In the same vein, Laubacher and Dell'Arocas (2010) identify four essential components referred to as the "genes" of collective intelligence that help explain its functioning: the "what" (common goal), the "who" (participants), the "how" (structure and processes), and the "why" (incentives). Unlike simple collaboration,

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collective intelligence is characterized by processes with specific objectives and decisions made collectively. It also relies on values such as individual responsibility, trust, interdependence, distributed leadership, and group autonomy.

Given this context and considering that we live in a dynamic and constantly changing world university students must be prepared to adapt to complex environments. In this regard, collective intelligence, complemented by information and communication technologies (ICT), offers a suitable environment for fostering joint work and the generation of new knowledge (O'Reilly, 2005).

Likewise, Gregg (2010) proposes seven principles for applying collective intelligence in practical settings: clearly defined tasks, user added value, data centrality and aggregation, facilitated access to information, multiplatform availability, a mindset for change, and continuous improvement. These principles demonstrate the potential of collective intelligence as a tool in university education, supporting processes such as decision making, collaborative research, and the development of academic projects.

However, its widespread application in the business and technology sectors, collective intelligence has not yet been sufficiently explored in the educational field particularly in higher education. For this reason, the following research question arises:

What is the degree of implementation of collective intelligence methods and tools in the education of university students?

In response to this question, this study aims to highlight the importance of incorporating collective intelligence methods and tools into university training processes. Laubacher and Dell'Arocas (2010) cite emblematic cases such as Google and Wikipedia as examples of collective intelligence applied through the use of ICT, emphasizing the synergy between technology and collective intelligence in educational contexts.

Alor et al., (2013) underline the vast potential that studying collective intelligence offers to the educational field, considering how educational challenges have evolved significantly since their origins. Along these lines, Lévy (2015) proposes a learning model based on decentralized, every day, and collaborative contexts.

Moreover, the European Higher Education Area recognizes teamwork as a key transversal competence in higher education (Maffioli et al., 2011), as it relates to cooperative learning a strategy that enhances academic performance (Johnson et al., 2009). Lastly, Ilon (2012) argues that the application of collective intelligence in education represents an emerging and underexplored field.

These findings reveal the challenge universities face in adapting their educational structures to meet the demands of an interconnected society. It is not enough to integrate ICT tools aligned with collective intelligence paradigms; a deeper transformation is required. As Ilon (2012) points out, many educators continue to use traditional methodologies that are misaligned with current needs.

Therefore, this study proposes to identify and design strategies for the effective implementation of collective intelligence methods and tools in the training of university students. This solution must involve the active participation of both teachers and students, as well as transformations in institutional thinking, organization, and management practices.

Finally, restructuring the learning process requires rethinking the models for planning instruction and evaluating knowledge. It is essential to shift toward frameworks that foster innovation and collaborative work over rote and individualistic approaches. Only in this way can university education align with the demands of an increasingly dynamic, interdependent, and knowledge driven world.

Reference Framework

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Theoretical Framework

Collective intelligence refers to the ability of a group of individuals to solve complex problems through collaboration and the exchange of knowledge and skills (Lévy, 1994). According to Lévy (1994), collective intelligence is an interaction process that involves communication, cooperation, and coordination among group members.

Neuroscience has contributed evidence regarding how the human brain is involved in collective intelligence. Studies have shown the fact of people working in groups, stimulated brain areas related to social perception, empathy, theory of mind, and decision making are activated. For example, in a study by Dikker (2017), it was found that during collaboration on cognitive tasks, participants' brains synchronized in certain regions, suggesting a neural connection between individuals in a group.

Moreover, research has shown that cognitive diversity within a group that is, the variability in thinking styles and cognitive abilities among its members can have a positive impact on collective intelligence. For instance, in a study on group decision making, Hong and Page (2004) found that cognitive diversity in a team improved the quality of decisions made, compared to homogeneous teams.

There is also the theory of complex adaptive systems, which is based on the idea that collective intelligence arises from self organization and the emergence of global patterns from local interactions among the system's agents. This theory holds that collective intelligence depends less on individual traits of group members and more on the structural and functional properties of the network connecting them (Mitchell, 2009).

In conclusion, collective intelligence is highly important as it encourages active student participation and offers various benefits. This tool supports learning, creativity, and innovation in skill development. Although it presents challenges, collective intelligence should be fostered to build more inclusive and creative learning communities, where students not only learn from it but also learn to manage its various tools, enabling them to face the challenges of today's world and the future.

Conceptual Framework

Collective intelligence is defined as the ability of a group to solve problems or perform tasks more effectively than an individual or a small number of people (Woolley et la., 2010). This ability is achieved through collaboration and the exchange of information among group members.

The importance of collective intelligence in university education: Collective intelligence can be a powerful tool for learning and innovation in higher education (Ponce & García, 2019). In this context, the implementation of collective intelligence methods and tools has become a growing trend due to the benefits it offers in terms of active, participatory, and collaborative learning (Kirschner & Erkens, 2013).

Several previous studies have examined the use of collective intelligence tools and methods in university training. For example, Capdeferro and Romero (2012) found that using wikis in university teaching can improve learning quality and promote collaboration among students.

Among the tools and methods used to foster collective intelligence in university student education, the most commonly used are:

- Wikis: Online tools that allow for collaborative editing and content creation (Klobas & Renzi, 2014).
- Online forums and discussions: Virtual spaces that enable idea exchange and collective knowledge building (Conrad & Donaldson, 2011).
- Social media: Platforms like Facebook, Twitter, Instagram, and WhatsApp allow students to interact with one another, share ideas and knowledge, and collaborate on projects.

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The implementation of collective intelligence methods and tools in student training can offer numerous benefits, such as improved collaborative learning, the promotion of creativity and innovation, the development of social skills, and increased student motivation (Dillenbourg, 2014).

According to the theoretical and conceptual framework presented, it is evident that collective intelligence emerges as a strategic pillar in the renewal of university education processes. In this regard, the present research aims to determine how collective intelligence methods and tools are used in higher education. Therefore, it seeks to identify the tools most commonly used by students in their academic lives, how they use them, and what challenges and limitations they face.

Based on this diagnosis, strategies will be developed to improve the implementation of these tools, enhancing collaborative learning environments. In a second phase, the study aims to identify specific barriers or obstacles that prevent the full potential of collective intelligence from being realized in university classrooms. These aspects include resistance to change, inadequate teacher training, and a lack of technological integration.

From these hypotheses, the study hopes to contribute both practical tools for university management and new data for pedagogical analysis.

Research Methodology

This research will be developed under a quantitative approach, which is characterized by the collection and analysis of numerical data with the aim of obtaining statistical results that can be generalized. Its main objective is to measure and analyze the relationship between variables using statistical and mathematical techniques, allowing for the generation of causal explanations, predictions, and valid generalizations about a population based on a representative sample. According to Johnson and Onwuegbuzie (2004), the quantitative approach employs rigorous methods for measuring variables and analyzing data, which enables the production of accurate and reliable results.

In addition, the study will have a descriptive scope, which aims to provide a detailed and objective characterization of a phenomenon without modifying or intervening in the studied variables. Its purpose is to achieve a deep understanding of the situation under investigation in this case, the implementation of collective intelligence methods and tools in the training of university students. According to López (2010), the descriptive approach allows for the analysis of the characteristics, behaviors, or dynamics of a specific group or phenomenon without seeking to establish causal relationships among its elements.

The target population will consist of university students from higher education institutions, ranging in age from 18 to 50 years. The sample will be selected through simple random sampling, ensuring representativeness and fairness in the selection of participants. The sample size has been set at 191 students. For data collection, structured surveys will be used, designed to capture information about the use and perception of collective intelligence tools in their academic training. These surveys will be previously validated in terms of their reliability and relevance and will be systematically administered to the selected participants, thus enabling proper statistical interpretation of the results.

Presentation and Analysis of Results

Identifying the collective intelligence tools used in higher education.

As part of the data collection process, a structured ten question survey was administered to a sample of 191 university students from various higher education institutions. The data collection took place between March and May 2023, in the city of Ibagué, Colombia. Regarding gender distribution, 59.7% of the respondents identified as female, 39.8% as male, and 0.5% as members of the LGTBIQ+ community.

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In relation to the objective focused on identifying the collective intelligence tools used in the academic environment, questions were formulated to determine which platforms, applications, or digital environments students have used to work collaboratively and build shared knowledge.

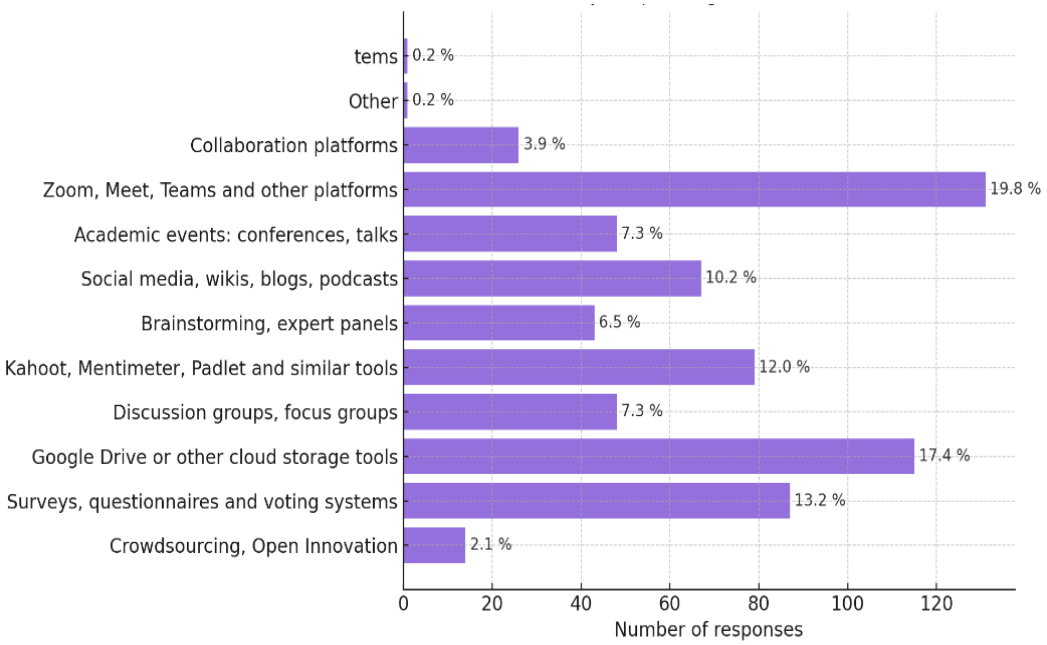

Figure 1. Which of the following tools have you used with your classmates to do work and build knowledge?

The results show that the most widely used tools are video conferencing platforms such as Zoom, Google Meet, and Microsoft Teams, followed by collaborative storage systems like Google Drive. These technologies allow for both synchronous and asynchronous interaction among participants, facilitating shared document editing, joint planning, and tracking of group tasks. This trend is consistent with the findings of Kirschner and Erkens (2013), who argue that the design of effective collaborative environments in higher education must integrate tools that enable positive interdependence and equitable participation.

Additionally, the use of complementary applications such as Kahoot, Mentimeter, and Padlet was recorded, as well as the use of virtual forums, wikis, blogs, social media platforms (Facebook, WhatsApp, Instagram), and interactive polling systems. These tools, by encouraging active participation and the exchange of ideas, contribute to the creation of collaborative learning environments, which Dillenbourg (2014) highlights as a key element for the development of collective intelligence in educational contexts.

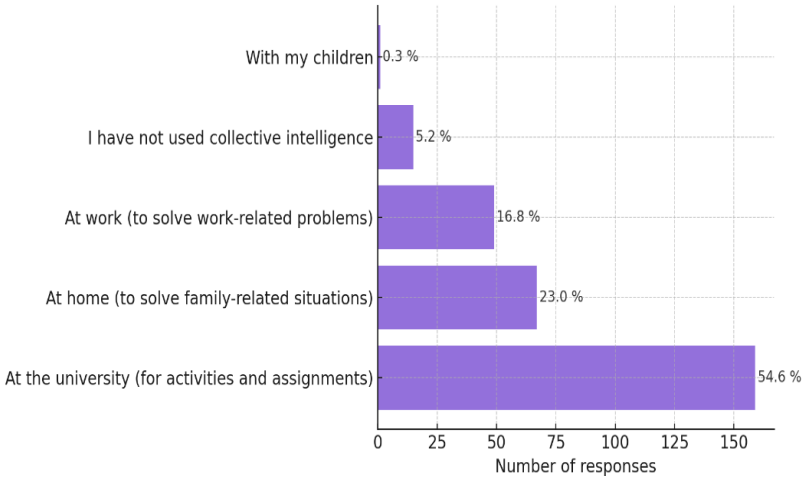

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Figure 2. In which of the following spaces have you used collective intelligence tools to solve a problem or perform a task?

The data obtained show that a high proportion of students have used collective intelligence tools in university settings to complete academic tasks and carry out group projects. This finding reflects a significant level of active participation and collaboration among students, indicating the presence of an academic culture oriented toward joint work and the collective construction of knowledge.

Moreover, the frequent use of these tools suggests a growing awareness of the importance of idea exchange and peer collaboration fundamental elements in the development of active and participatory learning environments. These environments not only enhance academic performance but also strengthen cross cutting skills such as complex problem solving, effective communication, and teamwork competencies that are highly valued in professional contexts. As stated by Johnson, Johnson, and Smith (2009), cooperative learning in higher education environments fosters positive interdependence and the development of critical social skills essential for students' comprehensive education.

Designing Strategies for the Implementation of Collective Intelligence Methods and Tools

In relation to the objective of designing strategies for the implementation of collective intelligence methods and tools, the following questions were posed to university students:

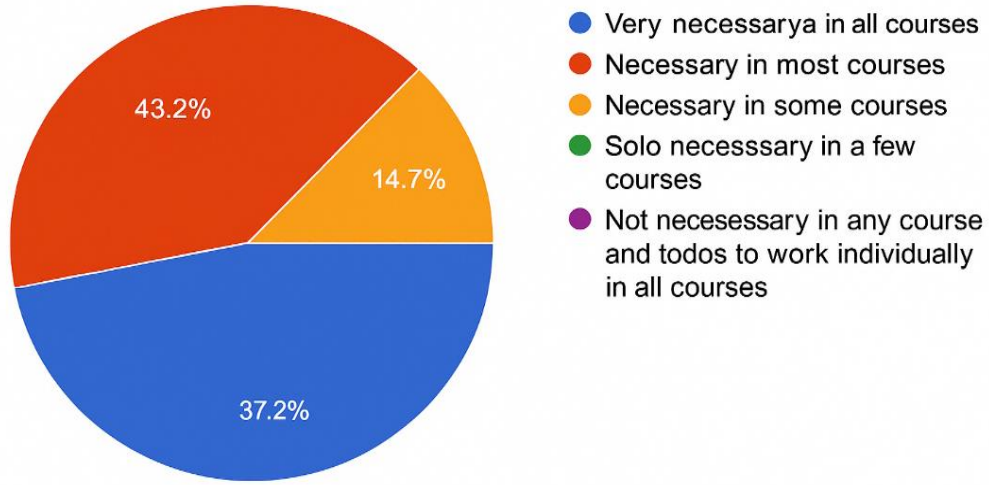

Figure 3. To what extent do you think collective intelligence can be beneficial in university education?

The results show that the majority of students believe that collective intelligence is necessary in university education, whether in all courses or in most of them. This trend reflects a growing appreciation for collaborative work and knowledge exchange as fundamental pillars of learning in higher education.

In this regard, the importance of promoting pedagogical models that integrate peer learning, teamwork, and the use of collaborative digital tools as core elements of teaching and learning processes becomes evident. Active student participation in environments where knowledge is constructed collectively not only enhances academic outcomes but also strengthens motivation, autonomy, and socio emotional skills. As Ponce and García (2019) state, collective intelligence is a powerful tool for promoting innovation and meaningful learning in higher education, especially when supported by technologies that facilitate interaction and cooperation.

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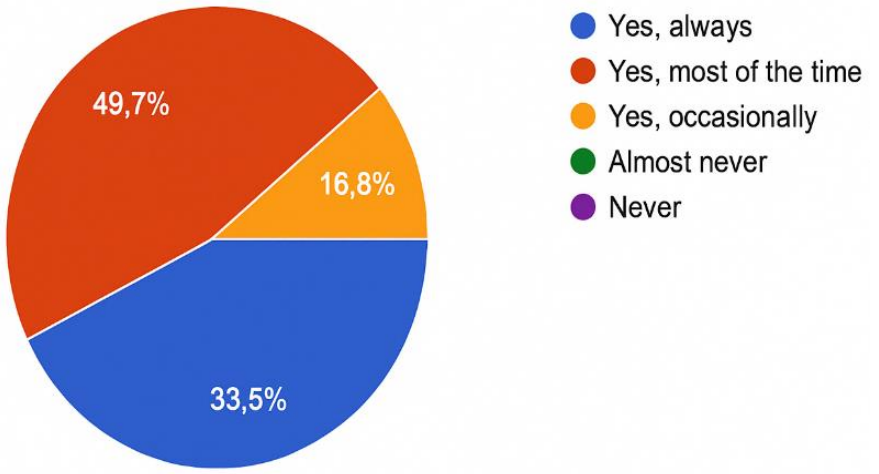

Figure 4. Do you consider that spaces for knowledge exchange among students have a positive impact on learning?

The results reveal that the majority of surveyed students affirm that spaces for knowledge exchange have a consistently positive impact on their learning process. This finding reinforces the idea that these spaces are not only valued by students but also constitute a key element in fostering a more participatory, meaningful, and collaborative competency oriented educational experience.

Peer exchange allows students to take an active role in their education, where they can express ideas, solve doubts collectively, and construct knowledge through the diversity of perspectives. This type of interaction encourages deep understanding, improves content retention, and strengthens social skills that are essential for both academic and professional life. As noted by Dillenbourg et al., (2014), well designed and well facilitated collaborative spaces promote deeper and longer lasting learning by supporting the co-construction of knowledge and the negotiation of meaning among participants.

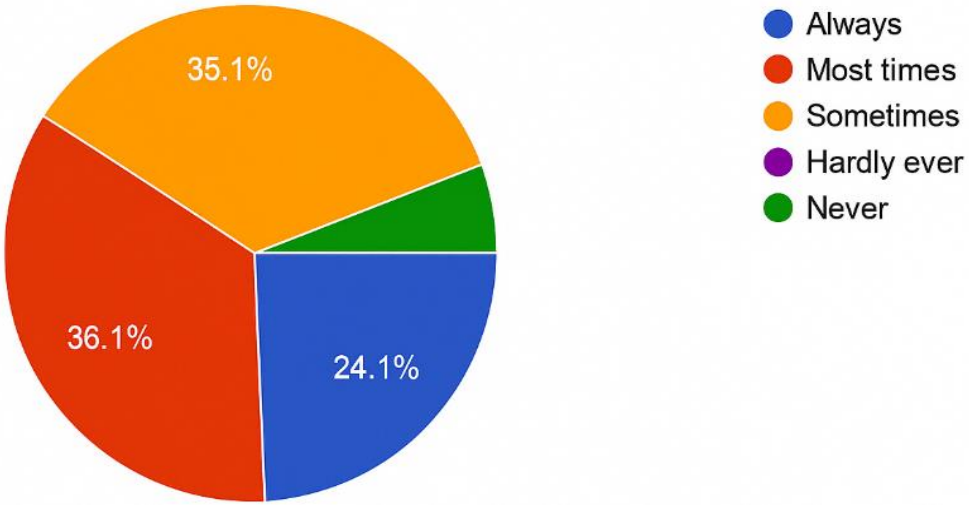

Figure 5. Have you experienced an increase in motivation when participating in group activities where collective intelligence is used?

The results indicate that the majority of students report an increase in motivation when participating in group activities based on principles of collective intelligence. This finding suggests that the implementation of collaborative methodologies not only contributes to academic learning but also plays a significant role in students' emotional engagement and willingness to actively participate.

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Motivation is an essential component of learning, and its enhancement through teamwork strategies can significantly improve the educational experience. When students feel that their ideas are valued, that they are learning from others, and that they are contributing to a common goal, they tend to engage in academic tasks with greater enthusiasm and persistence. In this regard, Moukhtar et al., (2015) argue that collective intelligence not only supports knowledge generation but also serves as a driver of intrinsic motivation, by providing dynamic, participatory, and student centered learning environments.

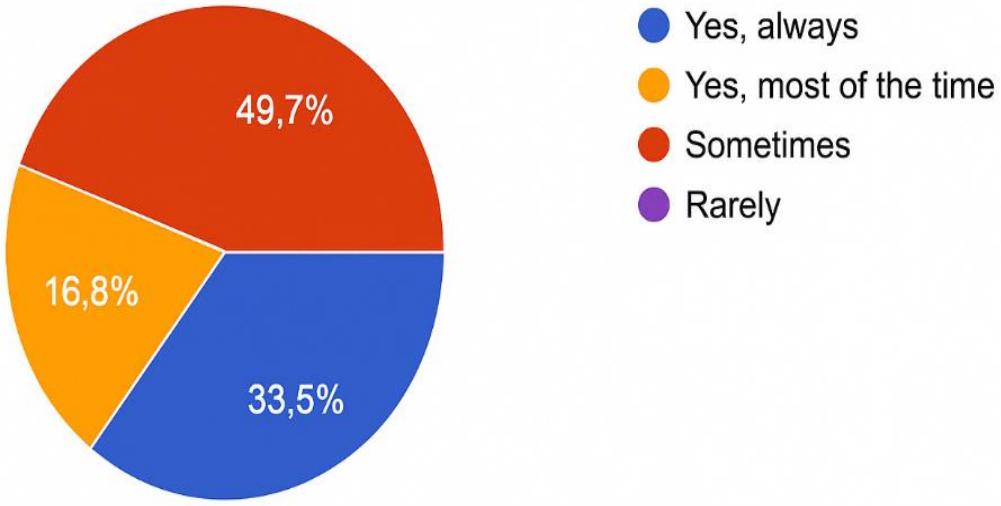

Figure 6. Do you consider that spaces for exchanging knowledge between students positively impact learning?

The results confirm that spaces for knowledge exchange among students have a positive impact on the learning process, reinforcing the need to promote collaboration and teamwork as central elements within university learning environments.

It is particularly significant to note that no student reported that these spaces almost never or never have a positive effect, demonstrating a broad consensus on the value of these collaborative dynamics. From a practical perspective, this finding reveals a favorable perception toward social learning, in which students not only receive information but also co-construct it actively with their peers.

Based on this evidence, it is recommended to design pedagogical strategies that promote and strengthen learning communities, supported by both digital platforms (such as forums, academic social networks, wikis, or interactive voting tools) and meaningful face to face interaction through group projects, debates, and in person activities. This combination of physical and virtual environments can enhance student motivation, participation, and holistic development. In this regard, Farmer (2018) emphasizes that the design of hybrid environments centered on collective intelligence contributes to creating more inclusive, participatory, and relevant educational experiences aligned with the challenges of 21st-century higher education.

Investigating the Barriers and Obstacles to Collective Intelligence

In relation to the objective of investigating the barriers and obstacles to the implementation of collective intelligence, the results show that although a significant number of students have had positive experiences exchanging ideas and collaborating on academic projects, recurring difficulties are also evident when working in groups. Some students reported that these difficulties arise occasionally, while others stated that coordination and collaboration with their peers are consistently challenging.

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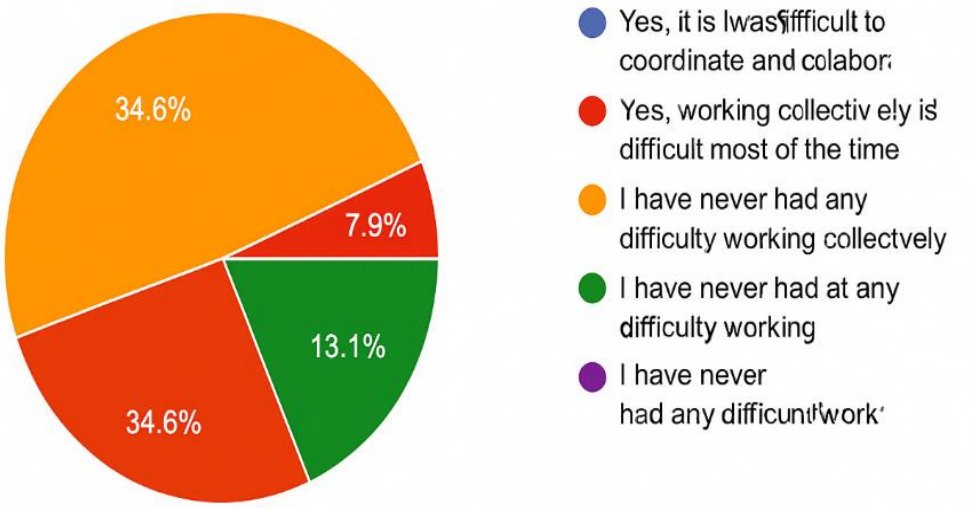

Figure 7. Do have you faced difficulties working collectively at the university?

Among the most common factors associated with these challenges are: a lack of teamwork skills, limited availability of time to meet or participate in joint activities, and low involvement or commitment from some group members. These situations negatively impact overall group performance and can hinder the achievement of shared objectives.

According to Capdeferro and Romero (2012), one of the main sources of frustration in collaborative learning environments is precisely the perception of unequal distribution of effort, difficulty in coordination, and disparate levels of participation among group members. If these dynamics are not properly managed, they can diminish the potential of collective intelligence.

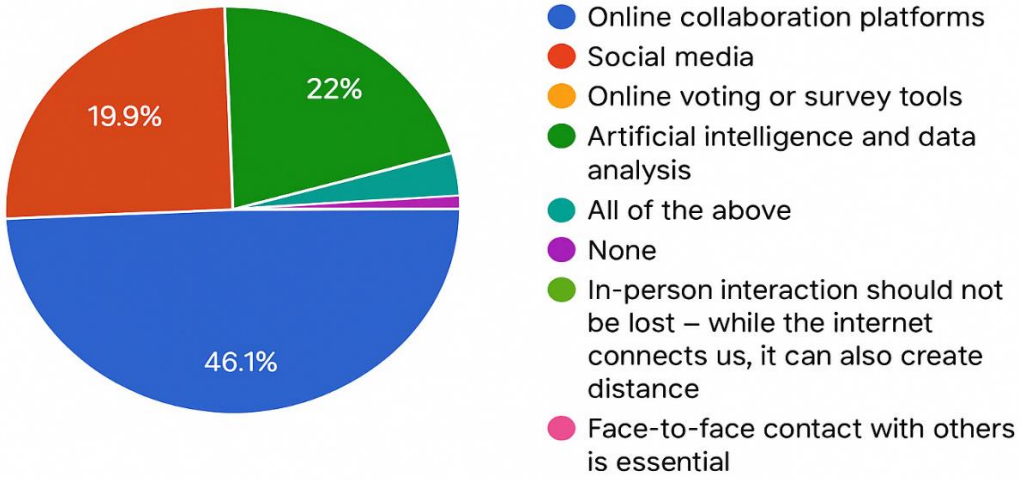

Figure 8. What technologies or tools do you think can enhance collective intelligence in universities?

The results obtained show that the previously mentioned technological tools (collaborative platforms, social networks, polling systems, wikis, among others) are perceived by students as key facilitators of collective intelligence processes. These technologies, by enabling the collection and analysis of data on interactions and collaboration patterns, contribute to the design of more effective strategies for group learning and educational innovation.

However, students also pointed out that the mere availability of tools does not guarantee their effectiveness, as adequate training is required for users to fully understand, integrate, and utilize their features.

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Additionally, the need to maintain a balance between meaningful personal contact and intensive use of technology is emphasized, in order to avoid excessive dependence on virtual environments that could weaken interpersonal relationships and group cohesion.

Likewise, persistent structural barriers were identified that hinder the optimal use of these tools in university contexts, such as resistance to change, lack of digital skills, concerns about privacy and data reliability, and the underrepresentation of certain student profiles in collaborative processes. As Moukhtar et al., (2015) warn, the success of collective intelligence in higher education depends not only on access to technology, but also on its ethical, critical, and pedagogically grounded integration within the learning ecosystem.

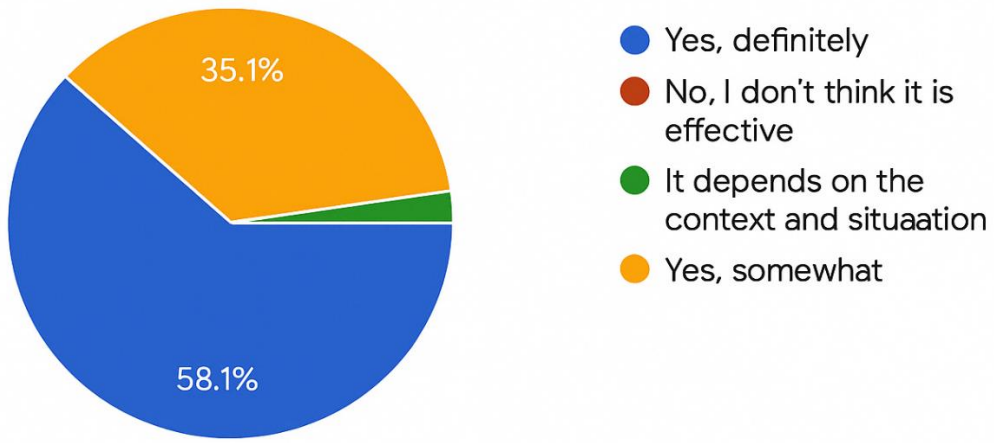

Figure 9. Do you think collective intelligence can help solve complex problems or find innovative solutions?

The results indicate that students recognize the potential of collective intelligence to address complex problems and promote innovative solutions by integrating different perspectives, experiences, and levels of knowledge. This collaborative approach can enrich decision making and foster creative processes that would not be possible individually.

However, several challenges were also identified that may hinder its effective implementation. Cognitive and cultural diversity, while a valuable asset in terms of plural thinking, can lead to difficulties in coordination, interpersonal conflicts, and disagreements about the approaches to be taken especially when facing highly complex challenges.

Additionally, students identified persistent barriers such as lack of trust among participants, limited effective collaboration, technological limitations, lack of clear incentives, and resistance to change from some team members. These barriers can restrict the full potential of collective intelligence as a strategic resource in university settings.

As stated by Hong and Page (2004), diversity within a group can be more valuable than individual ability in solving problems provided that differences are managed appropriately and an environment of respect and openness is fostered. These elements are fundamental to the effectiveness of collective intelligence

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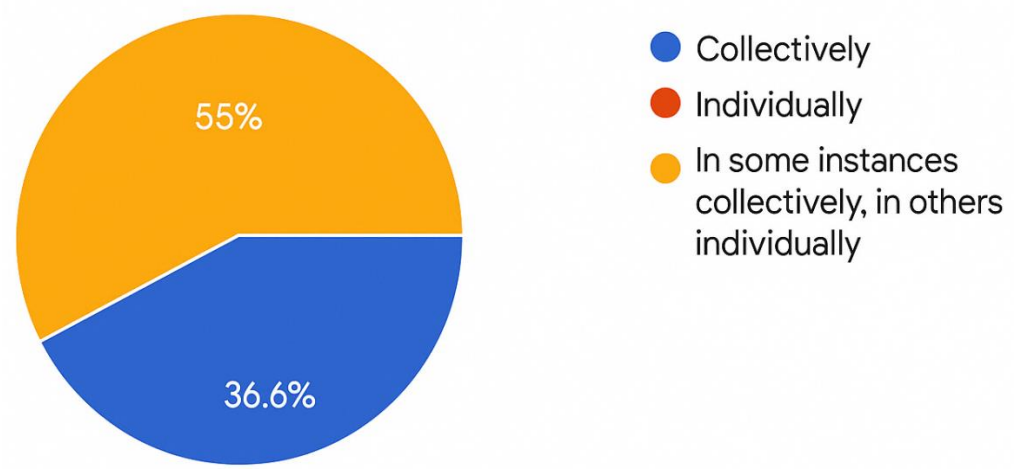

Figure 10. Do you think intelligence is best developed collectively or individually?

The results suggest that students value both individual and group work in the development of their intelligence, recognizing that each approach contributes distinct benefits to the learning process. However, they also agree that while teamwork offers advantages, it presents significant challenges that can limit its effectiveness if not properly managed.

Among the main barriers identified for the effective implementation of collective intelligence are lack of trust among group members, low participation from some individuals, coordination difficulties, and unclear management of roles and responsibilities. These factors can negatively affect team cohesion and the quality of outcomes achieved through collaboration.

Given this scenario, it is necessary to strengthen collaborative competencies through structured training processes that include: teamwork skill development, promotion of both individual and collective responsibility, clear role assignment within groups, and the strategic use of technological tools that facilitate communication, coordination, and monitoring of collaborative work. As Dillenbourg (2014) affirms, the effectiveness of collaborative learning environments depends largely on pedagogical design and the preparation students receive to participate meaningfully in them.

Conclusions

The findings of this research reveal a high level of engagement and widespread use of collective intelligence tools by university students, particularly in completing tasks and developing academic projects. This widespread use reflects a shift in the educational environment toward collaborative practices, peer interaction, and the active construction of shared knowledge. Such a shift is aligned with broader educational trends that value cooperation and digital integration as essential elements for modern learning.

Additionally, collective intelligence is not only actively utilized but also highly valued by students. They perceive it as a fundamental component of their academic formation, primarily due to its contribution to enhancing motivation, promoting meaningful learning, and developing critical soft skills such as communication, problem solving, and teamwork. Students particularly appreciate knowledge exchange spaces, which serve as effective environments for participation, social engagement, and in depth comprehension through diverse perspectives.

However, the study also exposes persistent challenges that hinder the full realization of collective intelligence in higher education. These include structural barriers such as inadequate training in collaborative methods, technological limitations, unbalanced group participation, and resistance to change factors that compromise the effectiveness and sustainability of collective intelligence strategies. Group dynamics also pose a challenge when roles are undefined or when trust and responsibility are not shared equitably.

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To address these issues, pedagogical innovation is necessary. Academic institutions should prioritize the design of learning experiences that incorporate clear role assignment, collaborative skill development, and formative assessments that value both individual and group contributions. Equally important is the need to cultivate a culture of collaboration, where teamwork is reinforced not only as a method but as a core academic and professional competency.

It is recommended that universities implement learning communities supported by a hybrid model blending digital tools (forums, collaborative platforms, and social media) with in person activities (debates, workshops, and group projects). Such integration would allow students to benefit from the flexibility of technology while preserving the human interaction essential to relationship building and emotional engagement.

Finally, achieving the full potential of collective intelligence in higher education requires intentional institutional support, including teacher and student training, the promotion of ethical digital practices, and the design of inclusive environments that allow all students to contribute meaningfully. By aligning teaching practices with these principles, universities can foster innovation, enhance academic outcomes, and prepare students to collaborate effectively in complex and interconnected professional contexts.

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