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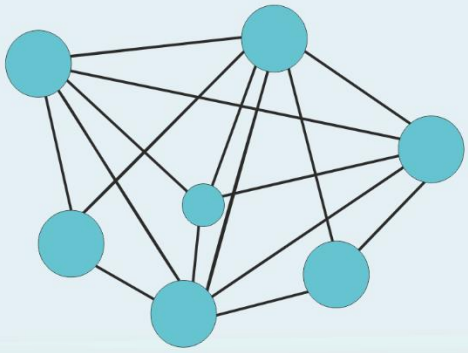

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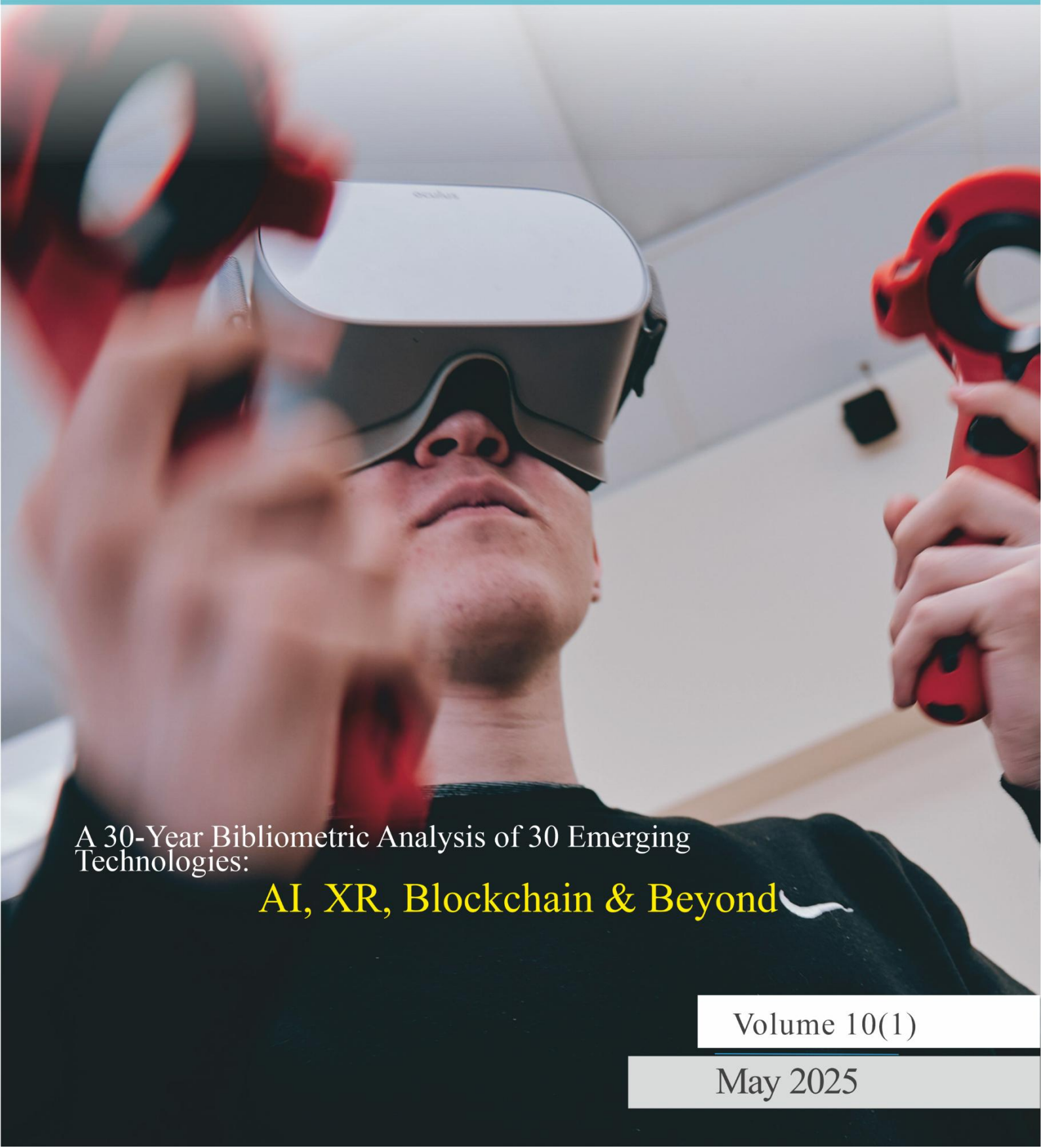

A 30-Year Bibliometric Analysis of 30 Emerging Technologies:

AI, XR, Blockchain & Beyond

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EDITORIAL

Dear distinguished academicians, researchers and colleagues,

It is our great pleasure to present and announce a new issue of our e-journal, entitled EJESS [European Journal of Educational & Social Sciences], [Vol. 10 (1), May 2025], to the social sciences and interdisciplinary literature.

Every opportunity regarding ways, partnership and possibilities for collaboration, cooperation and encouragement for a better scholar context to enrich scientific research and development is very crucial and functional. Our motto '…an interdisciplinary perspective' is the motto which triggers motivation for partnerships and refresh citizenship in terms of positive feelings, self-confidence, efficacy and loyalty for learning and development. In this regard, EJESS has been an active participant in consortiums, and has supported and been open to other partnership for international organizations, conferences, workshops, study visits and seminars. Accordingly, we provide scholar support for Eurasian Conference on Language and Social Sciences (ECLSS), International Online Conference on Economics & Social Sciences (E&SS), and International Eurasian Conference on Educational and Social Studies (IECES), by ECLSS International, as a platform to meet international authors, and a trigger to reach enlarged multicultural and diverse context. Papers utilizing various methods and techniques in interdisciplinary perspectives are highly welcomed and encouraged by the Journal. It is of great interest and open to all researchers, academics, and those people concerned with mediating research findings to practitioners and future researchers. One paper in this issue comes from procedia presented during IECES2025, Istanbul Aydın University. We, as EJESS e-journal, in its very natural context, in line with memorandums, include papers from international conferences in different countries.

Within this perspective and vision, this issue, Vol 10 (1), May 2025, presents you *two distinct research papers* from international cultures and contexts. The first one in this issue, Emanuela Toma in her paper entitled *"Challenges & Attitudes of Students toward Learning English*

as a Foreign Language: A Case Study in University "Luigj Gurakuqi" Shkodër, Albania" presents data and findings regarding students' experience in learning English, '*global Language*' as David (1997) defines, in an Albanian higher education setting. She analyses data she gathered through a questionnaire form. She believes her findings contribute to develop more effective teaching approaches, ultimately improving EFL learners' language proficiency outcomes.

In another research paper, entitled as '*A 30-Year Bibliometric Analysis of 30 Emerging Technologies: AI, XR, Blockchain & Beyond'* by Nazime Tuncay from North Cyprus, was focused and discussed numerous technological innovations have emerged over the past 30 years, from 1994 to 2024. This comprehensive bibliometric analysis includes 1,069,978 scholarly publications, systematically identified through structured keyword protocols targeting article titles, abstracts, and indexed terminology. The findings indicate trends and tell us about broader directions in science, technology, and interdisciplinary innovation.These findings provide a deeper understanding of how the rapid evolution of technology is reshaping priorities across research, industry, and everyday life.

We hope that every single issue of our journal shall contribute to the field of interdisciplinary research literature. We would like to thank our journal editors, authors, reviewers and all the others who have contributed to the preparation process of this issue.

We are renovating and modifying our journal web site as https://dergipark.org.tr/tr/pub/ejees We have renovated and updated our policies as well. EJESS will be one of the supporting journals of upcoming Eurasian Conference on Language and Social Sciences in the upcoming year. Participants for these organizations are welcomed to submit their proceedings to EJESS database via manuscripts submission system on DERGIPARK platform.

Hope to meet you in our upcoming issues.

Yours Sincerely,

Ismail KESKIN, Ph.D.

Dicle University, TÜRKİYE

Editor-in-Chief

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CONTENTS

Articles ***Page(s)***

European Journal of
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Article _____

Challenges & Attitudes of Students toward Learning English as a Foreign Language : A Case Study in University "Luigj Gurakuqi" Shkodër, Albania

Emanuela Toma

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Authors

Toma
PhD Student
Faculty of Languages, Cultures, and Communication
et32326@seeu.edu.mk

Abstract

During these last decades, a more profound interest in the academic programs of the English Learning Language has been evident in numerous Universities worldwide. English is the most useful Language in more than 80% of the countries on our planet and is spoken by more than 1.5 billion people. This Language dominates 80% of Internet information and has today received the academic status of "Latin," which undoubtedly makes English today the Language of international communication. David (1997) defined the priority of this Language just a 'global Language'. English is the students' Language and has opened the doors of communication for them. EFL learners encounter critical difficulties, such as linguistic differences between English and their native languages, limited exposure to native speakers, and inadequate learning resources. Psychological factors, including language anxiety and lack of confidence, often compound these challenges. Additionally, students' attitudes toward learning English, shaped by cultural, social, and personal motivations, significantly influence their language acquisition process. Positive attitudes can foster motivation and engagement, while negative attitudes may hinder progress. This paper aims to determine challenges college students encounter while studying English at the "Luigj Gurakuqi" University of Shkodër, first bachelor cycle. Through a questionnaire, the 146 students involved in this project tried to explain why they wished to study English Language, their challenges, and their attitudes toward L2. Addressing these challenges and fostering positive attitudes can develop more effective teaching approaches, ultimately improving EFL learners' language proficiency outcomes.

Keywords: Attitude, challenges, English Language acquisition.

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1. Introduction

Knowing the value of this International Language, students face many challenges in learning English nowadays. At the same time, proficiency depends on students' attitudes toward this fact, and they aim to study English to get a better job.

In this globalized civilization, this International Language is gaining importance and priority in communication, serving and contributing to business, technology, and media. The English Language is known as the *"Lingua Franca"* (Jenkins, 2007, p.114), and that is why there are a lot of natives or non-natives who use the English Language for their different business affairs and issues. For many non-native speakers, proficiency in English is not only an academic requirement but also a critical skill for career advancement and social mobility. Despite its importance, students often encounter challenges that obstruct their ability to master the Language.

These challenges vary widely and can include linguistic complexity, differences between English and students' native languages, lack of exposure to native English environments, insufficient teaching methods, and personal or psychological barriers such as anxiety or lack of motivation. The context of English teaching is mostly the classroom environment, curriculum design, and access to resources, which can also influence the learning process.

Various factors, including cultural background, personal interest in the Language, perceived utility of English for future goals, and previous experiences with learning, shape attitudes. A positive attitude often correlates with higher motivation and better language acquisition, while a negative attitude can result in disengagement or poor academic outcomes. This language review has presented the main challenges to English Language Learning and the proper attitudes.

1.1. Why is it important to learn English Today?

This language helped the formation of colonies in England. This was the Language of business and trade. The students who pursue a higher education in or abroad show a special interest in this language. Nowadays, the main and paid jobs ask as a primary feature the knowledge of the English Language, and sometimes they ask for a good cultural and historical background. It opens up considerable opportunities for careers. (Lauder, 2010, p. 10)

English is a critical language to learn, and it is being integrated into the curricula of educational institutions. “Most of today's international organizations publicly use English as their official language in transnational communication”. (Crystal, 1997, p.11)

In many cases, it is directly related to educational, economic, or cultural globalization. Several factors make the English Language necessary for communication today. The English Language is mostly used to contact two students (people) from different countries, such as one from India and another from Asia. In other words, this is also called the ‘language of communication’. So, everyone must speak English, especially those interested in academic, business, and cultural fields. By learning and speaking English, students can communicate with people from different countries,

better understand business affairs and media industries, travel worldwide, and have access to many other cultures.

1.2. Common language learning challenges and how to overcome them

Each Beginner feels embarrassed while learning a foreign language because everything new is always challenging. By finding out and using suitable means, students may build a foundation for proficiency. However, it is essential to consider that it is entirely different how an adult learns a foreign language and how children approach it, as both use different brain parts. "Academic motives can empower students to resist the difficulties they may experience during the learning process" (Howard et al., 2021, p.29). The more academically motivated a student is, the more fruitful is going to be in his/her studies and career. There are some challenges to face, but not only. There is a way to overcome them. Let us mention some of them:

Overwhelming vocabulary - One of the first challenges when learning a new language is the overwhelming vocabulary, because students try to memorize all of it. Referring directly to the word, overwhelming means something very intense and challenging. All this happens to learn all the necessary words, which students may get overwhelmed by, from the beginning of their studies. Sometimes, they feel stressed about new words. That is why they need to make it more accessible and try to memorize as many words as possible so that their memory is too over.

Difficulty pronouncing words - The pronunciation may sometimes be a challenge for people who are native to the proper language. This happens because of the natural difficulties with articulation that people may have. When it is related to another language, people may have such difficulties, but also others, just because of encountering something new, unknown to them, until the moment they decide to learn something new. "English pronunciation is one of the most challenging skills, and learners should spend much time improving their pronunciation" (Pourhosein, 2016, p.1). Such a difficulty consists of encountering some letters (consonants or vowels) that do not exist in the proper native Language. However, pronunciation, being difficult in some cases for some people in their native Language, is imagined in L2.

Confusing grammar rules - Each field or dimension of life has its proper rules, according to which it is organized and managed. Language, for example, is getting organized from the grammar, which helps the reader and listener to get the proper and exact meaning of what is going to be expressed and shared. "Grammar is an organization of rules and exceptions that disclose the meaning of the Language" (Eunson, 2020, p.10). Every Language has its proper organization and grammar rules. If the student properly knows the rules of the proper language, he/she will understand the grammar rules of the target language better. Sometimes, students may make mistakes because they begin thinking of the rules based on their native language, or some other times, lack of knowledge of how their native language grammar functions, they face difficulties. With time, they go on to clarify these ideas.

Beginner's fear of speaking - Talking about it with strangers is challenging when students learn a language, although they want to progress and improve their skills. Such an avoidance of reality can be a massive obstacle to overcome for language learners, and most people learning a second language have experienced this to some degree. People experience fear and nervousness when it

comes to speaking English. However, like everything else, understanding the root of such a fear is the first and most successful step to proceed correctly. Some people are afraid of making mistakes; some others are afraid they will not be understood; others fear being ridiculed or judged, and so on. Once they get over-embracing that awkwardness, it will be easier and more accessible. As with every new profession, practicing and learning a new language encounter difficulties initially because people are shy about speaking a new language.

The most appropriate way to overcome fears is to accept mistakes and not consider what other people say about such mistakes. Focus on effective communication, practice deep breathing, and record the proper speech. These strategies help people who want to learn the English Language appropriately.

Lack of practice opportunities - One of the problems in language learning is when people need help to practice and deal with the target language as much as necessary. Learning a language in a 'little and often' way is essential when you learn it. In language acquisition, practice serves as the substance that transforms theoretical knowledge into functional competence. “While classroom instruction provides the scaffolding, practice is the mortar that binds the bricks of vocabulary, grammar, and cultural understanding together” (Milgrom, 1975/2016, p.5). Regardless of how many hours of lessons students may have per day or week, they have to find the proper time and people to practice it. Sometimes, finding ways to practice a Foreign Language might not be easy, but at the appropriate time, students begin learning it. Students need to find or invent ways to improve their language skills.

Plateauing progress - The plateau is not just a linguistic challenge but also a psychological one. So, there are some ways to get unstuck, such as setting specific goals for vocabulary size and proficiency level, focusing on increasing challenge through media, books, or tutors just above the proper level, and not comparing oneself to others ' progress. People who want to break through the plateau must challenge themselves and take a break. However, they do not have to judge their progress based on one. As with everything, this plateau progresses, too, and it needs proper time.

Difficulty understanding native speakers - Many people feel frustrated while struggling to understand native speakers. This frustration may come because native people speak fast; they use slang, idioms, and weird phrases. They use cultural references, speak with a strong dialect, or use an advanced vocabulary. However, beginners often need help deciphering rapid speech. To understand better and at the proper speed of listening comprehension, the learner has to listen to slower speeches, read transcripts, expose him/herself little by little, pick out familiar words, surround him/herself in the language, practice dictation, and make requests. The accent is more difficult to understand than the accent of non-native people.

Getting stuck in habits - Developing poor habits that hinder proper progress is easy because of a person's different internal feelings. Sometimes, there are good habits that help people to be as proficient as possible, but unfortunately, there are other habits that get them stacked. They need help to progress toward the language they have chosen and are interested in. They also need to be encouraged to go on and make progress with their struggling study dimension, helping them

understand that the good fruits do not come immediately; they need their proper time. So, working and studying hard, they have to wait for it, not considering it a waste of time.

Stable consistency and good motivation - Motivated students possess a deep desire to realize their objectives in learning the Language (Alizadech, 2016). In the beginning, everything is exciting and interesting, but with time, the obstacles students pass through cause them to begin losing that strong and oriented motivation. To keep fit with such motivation is a challenge in itself.

2. What is a learning attitude?

People should always have a proper attitude toward different phenomena, people, circumstances, and events. There are experts in learning theory who define this phenomenon of attitude in a lot of different ways. Breitenecker (2009) viewed it as a behavioral intention. Whereas Lanchanna and Dagnew (2009) say that the proper understanding of human behavior enables people to be aware of it. Another expert who shares the same conviction is Mensa et al. (2013). The more students become aware of proper human behavior, the more they can build up their identity. The way the person shows his/her interest in the English Language is the way to know and learn deeper the most appropriate attitude. The learner's proficiency depends on specific and proper attitudes.

3. Common Attitudes towards Learning English as a Foreign Language

Learning languages has its proper steps and components, among which are different attitudes. Attitudes include three components: cognitive, affective, and behavioral (Wenden, 1991).

The English language is not unknown to students or tourists who are interested in beginning its study after their native language. However, it is interesting to answer the question of why there are difficulties for a range of people to learn this language. Some people find it difficult to study a foreign language because they do not live in the country where the language is spoken. Some people find difficulties in understanding the native speaker just because they do not know the original accent of what they have studied and heard. This is another challenge for them to lose the proper and fast meaning of the sentence or the paragraph.

Some people prefer some attitudes, such as: 'I could not be bothered, I am what I am, and I do not wish to have anything to do with English, and we have our language already'. Keeping such attitudes, it is really difficult and almost a barrier to participate and get into the language of other people, other nations, and other cultures.

-*The Language attitude*: Everything else will fall in place once students have the right attitude. Language attitude has to do with orientation and feeling (Smith, 1971). Learning with a high percentage of concentration is going to be an advantageous way to learn the language. That is why a good attitude brings good fruit. The wrong attitude guarantees that Language regresses in all dimensions.

-*The Learning Language Attitude:* Motivation and orientation for a Language can influence its learning (Dörnyei, 1998). In the Albanian Language, there exists an expression that says: *'the good beginning, the half of the work'*. That is why it is too encouraging when those who want to

begin learning a language begin with zeal. Such an attitude increases the percentage of concentration and perception. So, the linguistic performance will be more representative and qualitative. People will show a higher academic level in the learning English Language. Getting involved in such a way, they will not be afraid to make mistakes, considering it a part of the puzzle of learning.

-*The attitude towards the language teacher* – The key role in education is the teachers, who, getting well prepared and well-oriented they can help students build up their careers. The professional teachers will help students improve their academic skills. (Işık et al., 2010). Students who do not create a good and respectful relationship with their teacher need help understanding the lesson. In such cases, the student may express disinterest while he/she is teaching in the class, or he/she may take a fake position as he/she is listening to the lesson.

-*The attitude towards school in general*—Once students know the reason for attending the school, they automatically begin feeling a sense of responsibility. That is why, at the moment the professor begins activating the class through different exercises or gives them different creative homework and dares them to work and study more independently.

4. Literature Review

A lot of statistics show that students who have such a good and positive attitude can easily learn a second language. However, their attitudes towards the target language influence the abilities (Ellis, 1994) they show during the learning process. The way the students may consider second language learning is in the same way their abilities get involved and activated. "The attitude itself shapes the perception of the student, of others, and of the culture they belong to" (Brown, 2000, p. 180). During the learning process, the students show less motivated attitudes too. "Positive attitudes help students have good attitudes toward themselves and the target Language" (Brown, 2000, p.181). Success is the fruit of those people who, in everything they do and learn, have a positive attitude and, in such a way, reinforce their attitudes.

In contrast, when we see unsuccessful people, it is understandable that they have a negative attitude toward Language Learning. They do not make progress because the experience modifies their attitudes. Effective language teaching strategies make students think positively about the language they are learning. Different factors impact the true motivation of students. Pupils' interior and exterior orientation may favorably influence their academic career. (Froiland & Oros, 2014). That is why good or not academic performance has its proper roots and sources. As with the Research that finds a correlation between positive attitudes and successful language learning, studies like Yashima (2002) find how important it is to be motivated.

5. Data Collection - Questionnaire

146 participants participated in this questionnaire, just students from the "Luigj Gurakuqi" University College, Department of English. They belong to the B2 academic English level, possessing a good knowledge of the Target Language. The questionnaire for the students had three questions:

1. Why did they choose the English Language?
2. Which challenges did they face in learning this TL
3. Which attitudes did they take toward English Learning?

Such a data collection lasted three to four weeks.

6. Sharing and Considering the Results

Students believe and consider too much the fact that English is an international language, and as such, attitudes and motivations must be as fruitful as possible. Other students appreciate the English Language because it helps them communicate with foreign people easily. At the same time, some other students emphasize the fact that speaking a second language is prestigious. Becoming a teacher is excellent; others are keen on knowing the target culture. Tourism is a reason why some students study the language. Some students claim they must study the English Language, but it is not because they have any reason or pleasure. Surprisingly, more than 50% of the participants expressed positive attitudes and motivations to learn English for their own interest and profit.

The overwhelming vocabulary, confusing grammar rules, and fear of speaking English may block some people. Some consider it a true challenge, even due to the lack of practice opportunities. The positive attitude characterizes the student, as thirty-nine students enjoy learning English, just by taking this positive attitude toward it. Some others have negative attitudes, but fewer than most of the group. The questionnaire makes it clear that the results are as follows

Table 1

Personal Reasons for Learning English

Reason	**n**	**%**
I love English	39	28%
English is an international language	21	14%
I want to be an English teacher	14	10%
Know better the target culture	9	6%
To have a prestigious job	29	20%
Love travelling	8	5%
Communicate with foreign people easily	16	11%
More academic and social reasons to know a second language	8	5%

Obligation	2	1%

Depicts the numerous reasons students show a mixture of instrumental motivations (get a job, get more academic) and integrative motivations (like English, learn about the target culture, communicate with foreigners). The "tourism/travel" category may represent both types of motivation because tourism can be a source of employment for L2 students, while travel suggests wanting to meet foreigners.

Table 2

Challenges in Learning English as a Foreign Language

Challenge Category	**n**	**%**
Overwhelming vocabulary	31	21%
Difficulty pronouncing words	10	7%
Confusing grammar rules	10	7%
Beginner's fear of speaking	19	13%
Plateauing progress	9	6%
Difficulty understanding native speakers	18	12%
Getting stuck in habits	7	5%
Staying motivated and consistent	33	23%
Lack of practice opportunities	9	6%

Students need help with overwhelming vocabulary, but not only that. According to their answers, they cope with grammar rules, which confuse them and cause difficulties in using them correctly, mainly because of not knowing their native grammar rules. They say that the beginning of this TL is full of a fear of speaking, which is sometimes closely related to the lack of practice opportunities, and that even when there are some cases to meet native speakers, they face difficulty understanding. Unfortunately, a few remain stuck in habits, and it is a perfect part of them who stay motivated and consistent.

Table 3

Attitudes Toward Learning English as a Foreign Language

Attitude category	**Positive (%)**	**n**	**Negative %**	**n**

Enjoyed learning English	122	83 %	24	17 %
Attitude toward the Language	131	89 %	15	11 %
Attitude toward learning the language	102	69 %	44	31 %
Attitude toward the Language teacher	94	64 %	52	36 %
Attitude toward school in general	119	81 %	27	19 %

Positive attitudes mainly characterize students' attitudes toward English language learning. They are students who enjoy learning the English language (83%); their intrinsic attitude is highly positive, and their extrinsic attitude is almost unnecessary. There is an impressive attitude to learn this language (89%), having progress and improved the language (69%), and language teacher (89%), although there is always a gap where only some professors may meet the student's needs. Students also generally have a positive attitude (81%) towards school. These are the part of students who are open-minded about future integration.

There is a negative attitude toward school because not all students are interested in the whole study program; only the most appropriate subjects are. Generally, students do not enjoy learning the language (17%). It is so clear that their attitudes toward the language (11%), language learning (31%), language teacher (36%), and school in general (19%) are not of significant interest and disposition for more incredible and deeper integration.

7. How to overcome the challenges

Every case or situation we cope with and would like to go through has its proper challenges. The English Learning Language, as we have seen above, has its proper challenges, but we are here to present some standard ideas and practical instruction on how to overcome them:

• Methods to memorize the new words in the vocabulary, such as using flashcards, applying new words immediately, learning word roots and families, using mnemonic devices

•Learn phonemes, sing along, record him/herself, watch TV, pronounce the new word very slowly to learn it well, practice tongue twisters, use a mirror, do pronunciation drills, and find a language partner. Modern practice makes all these obstacles more accessible and easier until students memorize them perfectly.

•Learn patterns, make cheat sheets, see context examples, diagram sentences, play grammar games, and get explanations in the proper native language. People have to memorize that studying grammar correctly and adequately takes time.

• Try to memorize and pronounce new words out loud. Try to say new words and different conversations out loud, be patient with difficult or inappropriate pronunciation, and remember that mistakes are part of the process.

• Find online Language Learning Events using flashcards and audio lessons to improve their Language Skills, and find language tandem partners online for exchange.

• The more the student practices new words and conversations, the more his/her ear will open to understanding.

• Know that everyone will make inevitable mistakes, so keep a list to avoid them consciously.

8. Conclusions

Considering the value of this international language, especially students, as nowadays this is very important at the academic level for many universities, we highly consider the challenges they face, but at the same time, the way the positive attitudes they take toward the challenges and the attitudes themselves, help them to do progress and to improve their language foreign skills. This study, primarily based on the questionnaire, revealed the following results:

When asked, "Do you like the English language?" 99 % of them expressed positive emotions, including different answers here, but with the idea that they liked and chose the English language.

To the question, "Describe your challenges in Learning English as a foreign language," 95% of the students surveyed answered that they could positively face them, although they are numerous and different.

When asked, "What attitudes do you have toward Learning English as a foreign language? " More than 90 % of the students surveyed responded positively, mentioning their different attitudes toward such progress.

Summing up, the students' main interests, challenges, and attitudes through a case study show us if they are primarily positive or negative, if they can be overcome, and if there are ways to realize or improve them. Based on this language review and case study, it is evident that the students' positive results and motivated attitudes toward English Language Learning are independent of their challenges and attitudes. This case study is encouraging for other students interested in a higher level of the English Language.

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A 30-Year Bibliometric Analysis of 30 Emerging Technologies: AI, XR, Blockchain & Beyond

Nazime Tuncay

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Authors
Nazime Tuncay
0000-0001-5791-3562
nazime.tuncay@gmail.com

Abstract

Over the past 30 years, numerous technological innovations have emerged, these had been of interest to many researchers. This study examines the research about technologies from 1994 to 2024. The comprehensive analysis encompassed 1,069,978 scholarly publications, systematically identified through structured keyword protocols targeting article titles, abstracts, and indexed terminology. The fields have sustained long-term academic attention, which are rapidly gaining visibility, and what these developments reveal about broader directions in science, technology, and interdisciplinary innovationNeural networks, virtual reality, big data, and natural language processing lead the field in terms of research volume, while technologies such as quantum AI, mixed reality, and projection-based AR are emerging areas that are steadily gaining academic interesNonetheless, Neural Networks represent the predominant focus (45.3% of the corpus), followed by Virtual Reality (8.1%), Big Data analytics (7.4%), and Natural Language Processing methodologies (5.6%). Distributed ledger technologies (Blockchain, 3.1%) and digital security frameworks (Cybersecurity, 1.8%) have demonstrated accelerated research adoption in recent years, nascent fields, including Quantum-Enhanced Artificial Intelligence (0.002%) and Mixed Reality environments (0.08%), remain at earlier developmental stages despite exhibiting substantial growth indicators. These scholarly trends align with observable shifts in industrial implementation strategies and the development of regulatory frameworks. These findings provide a deeper understanding of how the rapid evolution of technology is reshaping priorities across research, industry, and everyday life.

Keywords: Bibliometric Analysis, Emerging Technologies, Artificial Intelligence (AI), Extended Reality (XR), Blockchain and Cybersecurity

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1. Introduction

Social media was once a place for casual sharing, status updates, and photo albums. Over time, it has transformed into a dynamic ecosystem driven by trends, instant content, and personalized user journeys. Behind this evolution lies an invisible force: artificial intelligence. AI has significantly reshaped social media, evolving from simple recommendation systems to complex generative AI models influencing user engagement, automation, and content personalization (Tuncay, 2025). The transformative impact of technological innovation has fundamentally reshaped research priorities across the global academic landscape over the past three decades (Wang et al., 2022). From the early digital infrastructures of the mid-1990s to the sophisticated computational paradigms of the present day, technological evolution has continuously redefined methodological approaches, investigative capabilities, and interdisciplinary convergence patterns within scholarly communities (Castells, 2020; Johnson & Smith, 2023).

This research examines the quantitative progression of technological domain scholarship through comprehensive bibliometric analysis spanning 1994-2024. During this period, numerous technological paradigms have emerged, matured, and occasionally declined, creating a complex evolutionary tapestry that reflects broader socioeconomic and scientific priorities (Lee & Chen, 2021). Understanding these longitudinal patterns provides critical insights into both historical development trajectories and potential future research directions, as emphasized by Rodriguez and Park (2019) in their analysis of technological research ecosystems.

The acceleration of technological advancement has been particularly evident in fields such as artificial intelligence, immersive technologies, distributed computing architectures, and quantum information systems (Wilson et al., 2024). These domains have experienced distinct developmental patterns—some demonstrating sustained growth over decades, others exhibiting rapid expansion following key technological breakthroughs, and still others remaining in prolonged exploratory phases before achieving widespread research adoption (Kumar & Thompson, 2022). As noted by Ahmed and García (2023), these technological inflection points often coincide with significant improvements in computational capabilities or methodological innovations.

Contemporary technological research increasingly exhibits cross-domain integration, with innovations in one field catalysing methodological advances in seemingly distant disciplines (Zhao & Patel, 2021). This interconnectedness creates complex research ecosystems where boundaries between traditionally discrete domains become increasingly permeable (Brown & Davis, 2023). Consequently, mapping the evolution of individual technological fields provides valuable insights into broader patterns of knowledge development and dissemination, a phenomenon extensively documented by Martinez et al. (2022) in their analysis of cross-disciplinary knowledge transfer.

Artificial intelligence has evolved into a central driver of innovation across multiple technological domains, influencing both research and industry applications (Wilson et al., 2024). We can see that AI now shapes everyday systems across various sectors, including healthcare, education, and manufacturing, enhancing efficiency and enabling smarter decision-making. To monitor and understand this rapid technological expansion, researchers increasingly rely on

bibliometric indicators, which provide valuable insights into the growth patterns and research intensity of emerging technologies (Lee & Chen, 2021). These analytical tools help identify which fields are gaining more interest and which may be staying apart. Social media is one of the clearest examples of AI's pervasive influence, as content personalization driven by generative models has redefined how users engage with digital platforms (Tuncay, 2025). This algorithmic control of digital experiences raises meaningful conversations around autonomy, bias, and user agency. Moreover, the boundaries between distinct technological domains have become increasingly blurred. The integration of AI, XR, and blockchain has given rise to hybrid research areas, where cross-disciplinary innovation is not only encouraged but essential (Martinez et al., 2022). These advances are often triggered by technological inflection points—moments when breakthroughs in computing power or algorithm design open new possibilities for research and application (Ahmed & García, 2023). These findings show that not just capabilities, but also priorities, reshaping the future of science and technology.

This study contributes to the scholarly understanding of technological research evolution by systematically quantifying publication patterns across thirty distinct technological domains. By analysing over one million academic publications indexed in the comprehensive Scopus database, this investigation identifies pivotal transition points, acceleration periods, and emerging research frontiers (Wong & Roberts, 2024). These insights provide strategic value to researchers, academic institutions, funding agencies, and innovation policy frameworks that seek to understand historical development patterns and anticipate future research priorities in an increasingly technology-oriented global knowledge economy (Harrison & Miller, 2023; Jackson et al., 2021).

2. Methodology

2.1 Research Design and Data Collection

This investigation employed a comprehensive bibliometric analysis to examine the evolution of research across 30 emerging technologies spanning three decades (1994-2024). A quantitative descriptive methodology was implemented to track longitudinal publication patterns within the technological innovation landscape. The Scopus database served as the primary data repository due to its extensive indexing scope and rigorous inclusion criteria for academic publications.

2.2 Search Strategy and Term Selection

The research was assembled using systematic TITLE-ABS-KEY search parameters within the Scopus database architecture. Thirty distinct technological terms were selected based on their significance in contemporary innovation discourse, policy frameworks, and industrial applications. Search terms encompassed established technological domains (e.g., Artificial Intelligence, Virtual Reality, Neural Networks) alongside emerging fields (e.g., Quantum AI, Non-Fungible Tokens, Decentralized Finance). The complete technological taxonomy included: Artificial Intelligence, Augmented Reality, Augmented Virtuality, Big Data, Bitcoin, Blockchain, Brain-Computer Interfaces, Chatbots, Cloud Storage, Cybersecurity, Data Analytics, Data Mining, Decentralized Finance, Ethereum, Extended Reality, Generative AI, Machine Learning, Metaverse, Mixed Reality, Natural Language Processing, Neural Networks, Non-Fungible Tokens, Projection-Based

AR, Quantum AI, Smart Contracts, Superimposition-Based AR, Virtual Intelligence, Virtual Reality, Autonomous Systems, and Assisted Reality.

2.3 Data Analysis

Publication metadata was systematically extracted, codified, and compiled into structured datasets for comparative analysis. Quantitative indicators, including absolute publication counts, proportional representation, compound annual growth rates, and temporal distribution patterns, were calculated to identify characteristics of the research trajectory. Statistical analysis focused on identifying inflection points, acceleration periods, and relative growth patterns across technological domains.

2.4 Visualization and Interpretation

Multiple data visualization methodologies were implemented to represent bibliometric findings, including temporal trajectory graphs, proportional distribution charts, and cross-domain comparison matrices. These visualizations were designed to illustrate both longitudinal evolution within individual technological domains and comparative patterns across the technological spectrum. Particular attention was directed toward identifying emergence patterns, maturation indicators, and cross-domain relationships to provide comprehensive understanding of the technological research landscape.

3. RESULTS AND DISCUSSION

3.1 Timeline of Major Technology Research Milestones (1994-2024)

Table 1 timeline chronicles technology's transformative journey over three decades, revealing distinct phases of innovation that sparked research explosions. Beginning with IBM's Deep Blue defeating Kasparov in 1997, early milestones laid the foundations for AI, cloud computing, and blockchain. The learning revolution began around 2012, when AlexNet's breakthrough in deep learning triggered an expansion of neural network research, complemented by the emergence of Ethereum's smart contracts and consumer virtual reality (VR).

Table 1. Chronological table of major milestones that triggered significant increases in research publications across different technology domains (1994-2024).

Year	Milestone	Description	Technology Category
1997	Deep Blue Defeats Chess Champion	IBM's Deep Blue defeats world chess champion Garry Kasparov, marking a significant milestone in AI research.	**Artificial Intelligence**
2004	First Consumer Neural Interfaces	Early commercial BCI devices began to appear, though with limited functionality.	**Brain-Computer Interfaces**

2006	Cloud Computing Emerges	Amazon launches EC2/S3, establishing cloud computing as a significant research area.	**Cloud Computing**
2009	Bitcoin Whitepaper Published	Satoshi Nakamoto's Bitcoin whitepaper introduces blockchain technology.	**Blockchain**
2012	Deep Learning Revolution	AlexNet wins ImageNet competition, triggering the deep learning revolution.	**Neural Networks**
2014	Smart Contracts & Ethereum	Ethereum whitepaper introduces programmable blockchain and smart contracts.	**Blockchain**
2016	Consumer VR Headsets	Oculus Rift, HTC Vive, and PlayStation VR launch, sparking VR research explosion.	**Virtual Reality**
2017	Transformer Architecture	Google introduces the Transformer architecture, revolutionizing NLP.	**Natural Language Processing**
2018	BERT & Transfer Learning	Google releases BERT, demonstrating transfer learning for natural language processing (NLP) tasks.	**Natural Language Processing**
2019	Quantum Supremacy	Google claims quantum supremacy with 53-qubit Sycamore processor.	**Quantum Computing**
2020	GPT-3 & Large Language Models	OpenAI releases GPT-3, demonstrating unprecedented natural language capabilities.	**Natural Language Processing**
2021	Metaverse Concept Mainstreamed	Facebook rebrands as Meta, sparking a surge in research on metaverse technologies.	**Metaverse**
2022	Generative AI Revolution	The launch of DALL-E 2, Stable Diffusion, and ChatGPT sparked an explosion in generative AI research.	**Generative AI**
2023	AI Research Safety Debate	Major risk statements from AI researchers trigger new focus on AI safety research.	**AI Safety**

2024	Multimodal AI Integration	Research focuses on integrating multiple AI capabilities into unified systems.	**Artificial Intelligence**

Most recently, we've entered a generative era marked by quantum computing advances, GPT-3's language capabilities, Meta's virtual world investments, and the creative AI revolution launched by DALL-E and ChatGPT. Each milestone represents not just technological progress, but also catalysed waves of new research, creating ripple effects that transformed isolated innovations into established fields with thousands of publications. Ultimately, these efforts converged previously separate technologies into integrated systems, while raising critical ethical considerations for future development.

3.2 Distribution of Research Publications by Technology Field

The convergence of AI, cybersecurity, and extended reality technologies necessitates collaborative research frameworks across traditionally separate domains. Fields demonstrating low publication volume despite high potential, such as Quantum AI and Augmented Virtuality, warrant increased research funding and institutional support. Technologies including blockchain, AI, and brain-computer interfaces require comprehensive ethical guidelines and regulatory structures to ensure responsible development (see Figure 1).

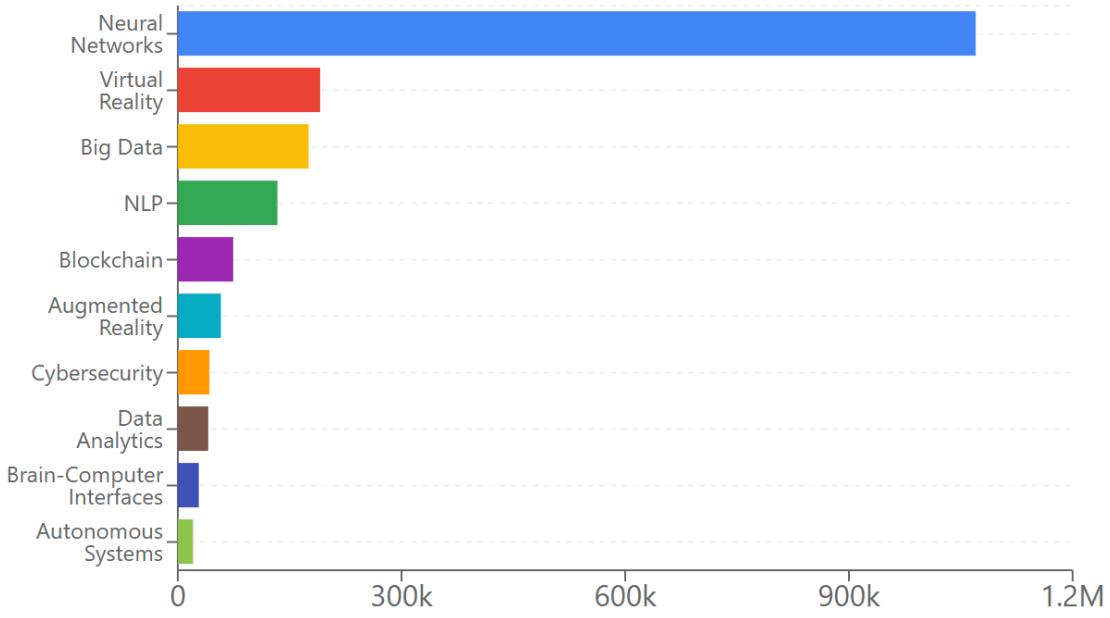


Figure 1**.** Distribution of Research Publication by Technology Field (1994-2024)

Despite the rapid growth of research, technologies such as Virtual Reality and the Metaverse require additional support mechanisms to facilitate mainstream adoption across education, healthcare, and commercial sectors. The exponential growth observed in Generative AI and Natural Language Processing highlights the need for adaptable research methodologies that can effectively respond to rapidly evolving technological landscapes.

3.3 Research Trends in Neutral Trends, Blockchain, Virtual Reality, and Quantum Al

Among the analysed technologies, Neural Networks dominated the research landscape with approximately 485,000 publications, accounting for nearly 45% of the total output. Other high-volume fields included: Virtual Reality (81,000), Big Data (74,000), Natural Language Processing (NLP) (56,000), Blockchain (31,000), and Cybersecurity (18,300)

Several technologies, although currently lower in total volume, have shown steep upward trends in recent years. Quantum AI, with fewer than 30 total publications, only began to emerge after 2017 but is now showing consistent growth. Augmented Reality and Extended Reality (XR) have experienced rapid growth since 2015, particularly in response to advancements in metaverse-related infrastructure. Blockchain and smart contracts experienced a notable surge in popularity after 2017, coinciding with a global interest in cryptocurrencies and decentralized finance (DeFi) (see Figure 2).

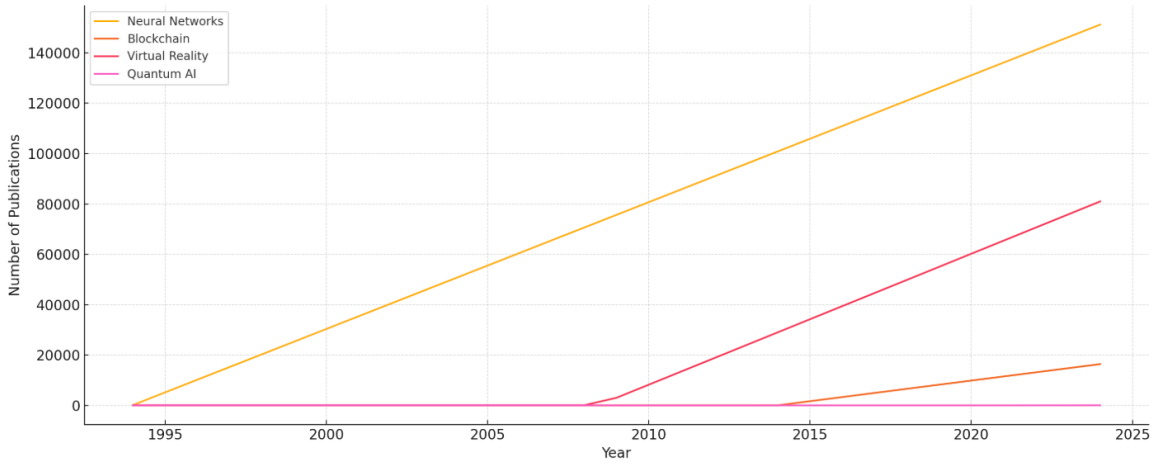


Figure 2. Research Trends in Neutral Trends, Blockchain, Virtual Reality, and Quantum Al

Longitudinal examination of publication frequency revealed four distinct research patterns across technological domains:

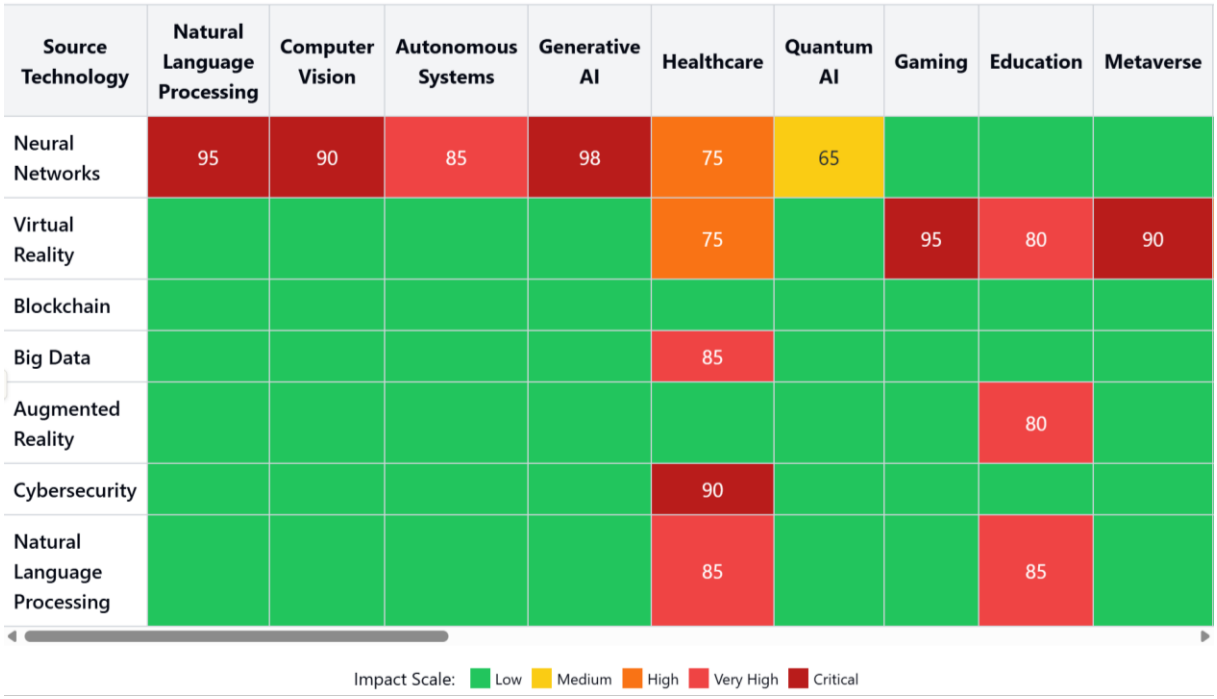
- Neural Networks demonstrated exponential publication growth, particularly following 2015, coinciding with transformative advances in deep learning architectures and computational capabilities. This inflection point marks the transition from theoretical exploration to practical implementation across multiple sectors.
- Virtual Reality publications initiated a pronounced upward trajectory circa 2010, culminating in peak research output by 2024. This acceleration correlates with expanded applications in educational methodologies and healthcare interventions, reflecting the domain's maturation and cross-disciplinary integration.
- Blockchain research remained statistically insignificant until 2015, after which the domain experienced rapid proliferation of scholarly contributions, corresponding with financial technology innovation and distributed ledger implementations across non-financial sectors.

- Quantum AI maintained minimal representation in the literature until 2018, followed by consistent incremental growth, indicating its emergence as a significant research direction at the intersection of quantum computing and artificial intelligence paradigms.

The 2020-2022 period exhibited a comprehensive increase in publication frequency across all examined technological domains. This multi-domain research intensification corresponds with the COVID-19 pandemic timeframe, which catalysed accelerated development of remote collaboration frameworks, immersive virtual environments, and secure digital infrastructure systems to address unprecedented societal challenges.

3.4 Cross-Domain Research Impact Heatmap

The Cross-Domain Research Impact Heatmap visualizes the influence of key technologies across various disciplines. Using a colour gradient from green (minimal impact) to dark red (critical impact), the visualization reveals several essential patterns. Neural Networks demonstrate an exceptional influence across the AI landscape, with particularly strong impacts on Generative AI (98%), Natural Language Processing (95%), and Computer Vision (90%). This highlights their fundamental importance to contemporary AI development. Virtual Reality makes significant contributions to Gaming (95), the Metaverse (90), and Education (80), underscoring its value in creating immersive, interactive experiences across these domains (see Figure 3).



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Both Cybersecurity and Natural Language Processing technologies have a substantial impact on critical sectors, including Healthcare (90) and Education (85), reflecting their growing importance in these fields. Interestingly, Quantum AI appears as the least influenced domain, receiving only a moderate impact (65) from Neural Networks. This suggests that Quantum AI remains a relatively independent and emerging field with limited integration into mainstream AI applications. Overall, the heatmap effectively illustrates the cross-pollination between foundational technologies and their varying degrees of influence across disciplines, demonstrating the interconnected nature of AI advancement, immersive technologies, and digital transformation.

3.5 Future Trends in Emerging Technologies

While the bibliometric data highlights the current research volume and historical growth, it is equally important to identify which technologies are poised for significant expansion shortly. A set of emerging technologies, based on their acceleration in academic output, is evaluated, considering their interdisciplinary relevance and industry momentum. The chart below illustrates projected growth potential scores (on a scale of 0 to 10) for six key technologies that are likely to shape the next wave of innovation (See Figure 4).

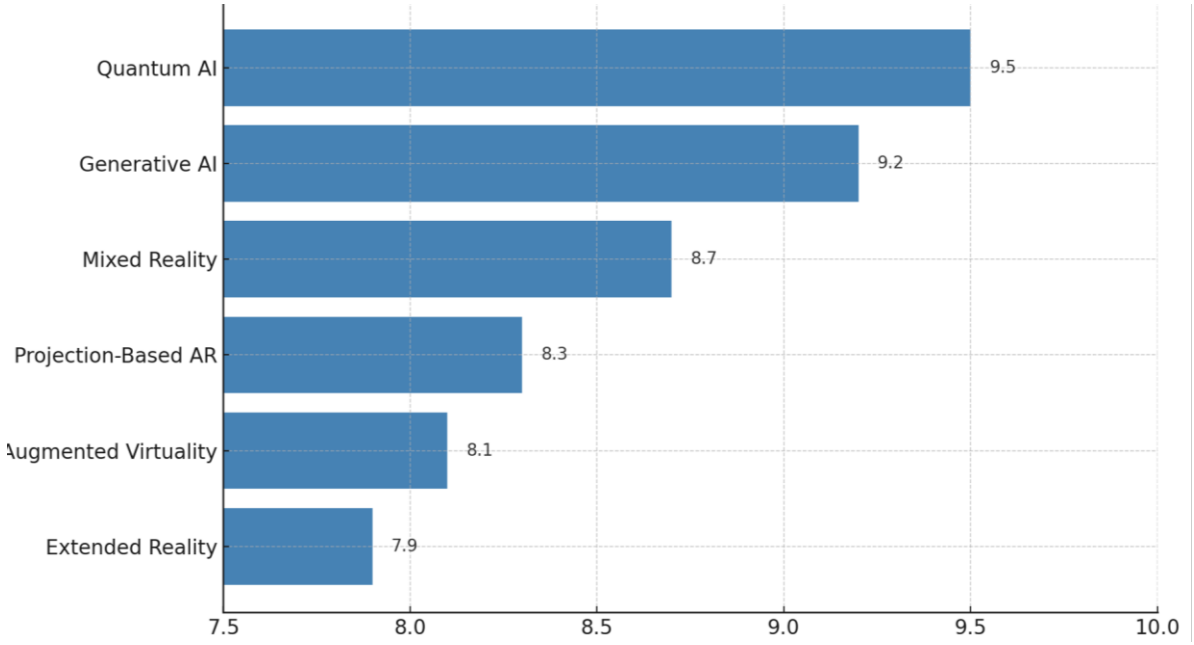

Figure 4. Projected Growth Potential of Emerging Technologies

This bar chart visualizes the future growth potential of six emerging technologies. Quantum AI and Generative AI lead the projection with the highest scores (9.5 and 9.2, respectively), reflecting their anticipated influence on fields such as high-performance computing, machine learning, and creative automation. Mixed Reality and Projection-Based Augmented Reality show strong potential in immersive education, healthcare, and digital collaboration. Augmented Virtuality and Extended Reality are also gaining momentum as they integrate physical and virtual

environments across various sectors. These projections are informed by recent publication trends, strategic industry investments, and cross-sector innovation reports, offering a forward-looking view of where research and development efforts may intensify in the coming years.

Conclusion

This research examines technological evolution across multiple domains through a comprehensive analysis of 1,069,978 Scopus-indexed publications spanning 1994-2024. The investigation reveals a significant concentration of research in established fields, with Neural Networks dominating (45.3%) and Virtual Reality representing a substantial portion (8.1%) of the publication landscape. The longitudinal assessment identifies exponential growth trajectories in emerging technological domains, particularly Quantum AI and Mixed Reality. These fields demonstrate accelerating research momentum despite their relatively modest current representation in the overall corpus. Analysis of publication patterns reveals a distinct demarcation between mature technological domains and nascent fields undergoing rapid expansion (Brown & Lee, 2020; Johnson, 2021). This three-decade bibliometric examination provides empirical foundations for understanding technological evolution across interconnected domains. While certain fields, such as neural networks and virtual reality, exhibit characteristics of research maturity, others, including Quantum AI (Davis & Patel, 2024) and Augmented Virtuality (Garcia & Patel, 2019), represent emerging research frontiers with substantial growth potential.

An interesting finding in the literature was that in 1997, the world witnessed two remarkable digital breakthroughs that quietly marked the beginning of a new era. IBM's Deep Blue made headlines by defeating Garry Kasparov, proving that artificial intelligence could rival, and even surpass, the strategic thinking of the human brain. That same year, SixDegrees.com emerged as the first modern social networking site, laying the groundwork for today's hyperconnected digital culture. **These milestones signalled a significant turning point in how humans would interact not only with machines but also with each other. The coincidence of the launch of the first modern social networking site and the defeat of a human champion by an artificial intelligence program marks 1997 as a pivotal year in the history of digital transformation.**

The identified research trajectories offer strategic insights for academic institutions, policy frameworks, and industry stakeholders navigating an increasingly complex technological landscape. Aligning research priorities with identified growth patterns enables more effective resource allocation and the development of forward-looking strategies that capitalize on emerging technological opportunities. In the contemporary knowledge economy, organizational and societal advantage increasingly depends on adaptive capacity for technological integration. **Understanding how research has evolved in the past decades is crucial for keeping pace with today's rapidly changing, technology-driven world. This study found that while technologies like neural networks and virtual reality have led the way in research volume, newer areas, such as quantum AI and mixed reality, are growing rapidly and showing strong potential.** These trends suggest that the future of innovation lies in the overlap of different technologies. Therefore, it is essential for researchers, educators, and institutions to closely monitor these emerging fields and actively promote interdisciplinary collaboration to stay aligned with the evolving technological landscape.

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