



## **FROM CHALKBOARDS TO CHATBOTS: A REVIEW ON HOW DIGITALIZATION SHAPES GEN Z'S LEARNING EXPERIENCE**

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### **ABSTRACT**

This review explores the role of Digital Education in shaping Generation Z's learning experiences. The study shows how education has shifted from traditional chalkboards to digital tools like AI chatbots, e-learning platforms, and online resources. The purpose of this paper, "From Chalkboards to Chatbots: A Review on How Digitalization Shapes Gen Z's Learning Experience," is to review existing literature on digital transformation in education and how it improves academic efficiency and student engagement. This study aims to investigate how Gen-Z's students are adapting "Digital Education to enhance academic learning". To identify the research trend with the help of the Scopus database and VOS VIEWER over a period of 10 to 12 years. The Methodology of this review paper involves a comprehensive analysis of existing studies on digital education and Gen-Z's learning trends. Using keyword-based searching, such as Generation-Z's, digital education, Artificial intelligence in education, chatbots in learning, and online learning, important material was found from scholarly databases. To identify trends that are related to learning, Adoption, and digital transformation in education, The Articles selected were reviewed to provide an understanding of how digitization improves learning outcomes. Both qualitative and quantitative results from earlier studies were taken together. The reviewed literature suggests that digitalization increases Gen Z's academic productivity by providing adaptive AI engagement, improved resource access, and self-learning. Although there are problems with excessive screen time and distractions, chatbots and e-learning provide engaging, individualized learning. Combining digital and traditional methods improves engagement and learning outcomes." This study shows that how Gen-Z's academic learning and engagement has been reshaped through digital transformation with the help of AI tools, e learning platforms, etc. with a combined and balanced mixture of traditional and digital methods, there has been significant enhancement in



learning and productivity in Gen-Z's students' academics with less distraction or excessive use of technology.

**Keywords-** Generation Z, Digital Education, Academic Efficiency, Artificial Intelligence in Education, Chatbots in Learning, Online Learning, E-learning Tools, Digital Transformation in Education.

## INTRODUCTION

The learning environment has changed rapidly in the last two decades, from the traditional chalkboard classrooms which also is known as "black board era ", to digitally operated classrooms, that includes screens, tablets, and interactive platforms. (Herczeg, 2021) For Generation Z—students born between the mid-1990s and early 2010s—this change was not at all sudden but rather important to their educational experience. Gen Z learners, unlike previous generations, have grown up in an era where digital tools, internet connectivity, and multimedia resource have been put into daily life, influencing not only how they collect information but also how they process, retain, and apply knowledge.

With the rapid development of the technologies (Arisoy, 2022) Digitalization provides an opportunity to enhance the learning experience. The education system should strengthen its digital skills and adapt teaching approaches to online environment. Proper adoption of digitalization provides more interactive and effective learning for GenZ students. (Anja Macan, 2022) The digitalization of learning methods has opened many doors for accessible educational contents. (Elena Frolova a, 2025). Depending on the Gen Z's strong dependency on social media and digital platforms also effect their benefit and association with education, which emphasizes both advantages and disadvantages in their learning journey (Ruchi Sao, 2024)

Generative AI has the capacity to rapidly improve personalized learning through flexible learning system. These systems use machine learning techniques to analyse student performance, learning pace and preferences. Based on this data, the AI can be tailored to be fit for the needs of any individual student, ensuring that the learning experience is refined for their unique learning journey. By continuously analysing student interactions and performance, the AI can create a personalized syllabus that evolves in real time, allowing for a more efficient and effective learning method. (Rizv, 2024) In addition, engaging technologies such as augmented reality are being combined into classrooms to develop an interactive and engaging learning experience that enhances the academic skills of Gen Z learners (Kartika Rinakit Adhe, 2024).

Higher Education Institutions (HEIs) had to transform all their teaching methods and learning activities from traditional system to online system. (Rawal, 2024) However, the transformation from chalkboards to chatbots is more than just a digital advancement—it marks a revolution in education field. In Traditional classroom system, where the teacher was the central source of knowledge, are slowly being replaced by collective and personalised learning.



Nowadays students are not only bystanders of information but active contributors in developing knowledge through digital platforms, online communities and interactive tools. The innovative use of digital tools in teaching can provide millions of opportunities for students to develop their language skills, critical thinking, decision making and creativity (Aleksandra Gagić\*, 2023) This transformation has introduced new teaching methods, innovative assessment techniques, and opportunities for flexible learning operated by artificial intelligence and data analysis.

For Gen Z's, digital learning is not just a method but a necessity. This generation is known for its ability to multitask, quick processing of information and prefer visual, interactive and concise contents over lengthy text. Platforms including ChatGPT, Google Gemini, Microsoft Copilot, Khanmigo, NotebookLM, YouTube educational tutorials, gamified learning applications and virtual classrooms are in fusion helps with the learning methods and habits of Gen-Z students all together for example a math concept that used to be explained on a traditional chalkboard can now be understood through ChatGPT or Gemini for step-by-step problem-solving. Research also shows that Gen Z's constant screen exposure influences both their attention and their learning patterns (Fábio Sousa Gomesa José Chen-Xub, 2024). Unlike older generations who relied heavily on teachers and textbooks, Gen Zs are advance in environments where they can explore knowledge at their own pace, receive instant feedback and communicate with peers globally through online communities (Frolova, 2024). Their vast digital lifestyle also shapes how they flexibly approach, communicate and their educational engagement in modern era (Fisu, 2024)

Moreover, Gen Z's learning experience is deeply tie connected to the universal culture of network. With smartphones, laptops and high-speed internet at their fingertips, these students are no longer bounded to their classrooms. They can easily connect with the peers across the world, join virtual lectures from top universities or even can take part in global online competitions. This constant interaction not only sharpens their mind but also builds cultural awareness, global competence and diversity especially with the support of AI-powered tools (Ulla, 2024). At the same time, Gen Z's strong concern for social responsibility highlights that digital education should go beyond academic content, providing learners with the skills and ability to tackle global challenges.

However, at the same time, digitalization of education brings new challenges. (Ruiz-Palomino, 2021) such as cultural combination, digital distractions and unfair distribution of resources between developed and developing regions, where digital certifications may increase gaps rather than reduce them (Kinga Zdunek1\*, 2024) . It also raises important questions about the strength of learning, digital distractions, fair access and the awareness of both educators and institutions to keep up with evolving technologies. For example, while some learners develop in a digital environment, others may feel overwhelmed by constant knowledge or lack of personal interaction. These challenges show the need for critical evaluation of whether digitalization truly improves academic ability or simply replaces traditional barriers with modern ones.



As education continues its digital evolution, the main question is not whether technology will define the future of learning as it already does. The greater challenge lies in determining how to utilise these tools responsibly and interactively to meet the desired needs of Gen Z learners. The shift from chalkboards to chatbots is therefore not merely a matter of technological substitution but a deep review of how education functions in a digital era. Understanding this transformation is essential for building and learning systems that are not only technologically advanced but also complete, fair and capable of preparing a generation that will face unknown challenges both globally and technologically.

### **OBJECTIVE**

- To critically review the existing literature on digital education and its influence on Generation Z's learning experience.
- To analyse the recent trends related to digital transformation in education over the last decade using scholarly databases.
- To evaluate the impact of digital technologies such as AI chatbots, e-learning platforms, and online resources on Gen Z's academic efficiency, engagement, and learning outcomes.

### **METHODS**

The data for this study is collected with the help of Scopus as it provides comprehensive coverage of literature, filters content through strict quality checks and globally trusted metrics. This study explains the current trends; topics being studied and possible future directions in the field of digital education.

The methodology consists of three main stages: data collection, data screening, and analysis.

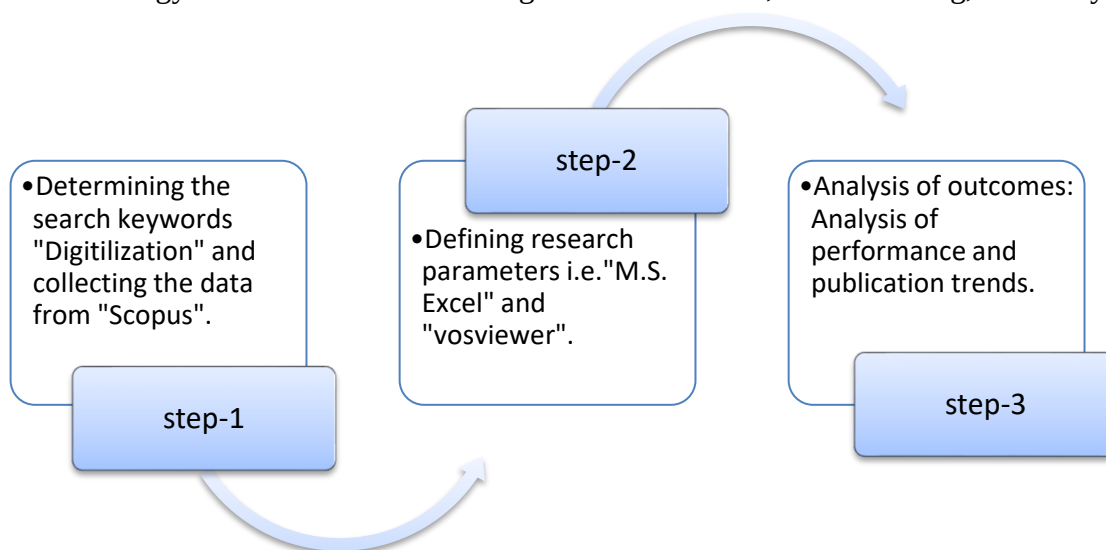


**Figure 1: Flow Chart Representing a Systematic Review**

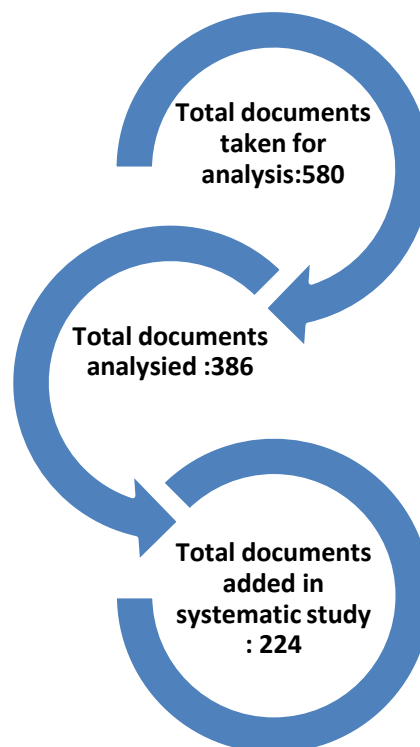


### **Data Collection:**

This systematic study is based on previously published research papers and articles which are stored on Academic databases such as Scopus, Web of Science, Google Scholar, and ERIC etc., The data for this study was collected using various keywords such as DIGITALIZATION, GEN-Z LEARNING, ACADEMIC EFFICIENCY, DIGITAL EDUCATION, AI IN EDUCATION, E-LEARNING TOOLS, STUDENT ENGAGEMENT etc., This study includes journal articles, conference papers and review papers gathered from the 10 year period (2014-2024) to capture the rapid digital transformation in education relevant to Generation Z.

### **Data Screening:**

The initial search concluded with many articles. After analyzing the search limit, the search limit was reduced to 580 and then removal of the research papers to 224.



This process shows precise screening and strict methodology by effectively narrowing the number of documents from 580 to 224. This significant reduction in number of studies i.e. 34% from the initial to the final steps of the process defines the strict screening applied, to make sure that the most suitable studies are included at the end of this systematic study, which improves the effectiveness and reliability of the research outcomes.



### **Data Analysis:**

The selected studies were analyzed using systematic methods to identify distribution trends, most cited works, contributing authors and frequently used keywords. Additionally, a subject-based analysis was performed to categorize the literature into major components: (a) transformation of traditional teaching system into digital platforms, (b) Gen Z students learning characteristics and priorities and (c) the role of transforming technologies such as chatbots and AI tutors in shaping education.

This dual approach—quantitative systematic method and qualitative subject-based analysis—provides a comprehensive view of how digitalization has redefined learning activities, academic efficiency and student engagement etc., for Generation Z students.

## **RESULTS**

### **Bibliometric Maps**

The data about citation, author keywords and bibliography of 480 publications were analyzed using VOSviewer software. At Integral University, Lucknow, mainly Scopus is provided to the research scholars. VOSviewer software is designed for generating bibliographic maps. A group of items linked with author, keywords and countries has been provided all together in this research, additionally including bibliographic maps.

If two authors contribute together for the two different countries to publish a specific research publication, then the publication status connection between the two countries will be determined with the help of the co-authorship analysis and to identify how various author keywords are interlinked with each other can also be done with the help of co-authorship analysis.

### **Keyword Analysis**

Keyword analysis provides an essential component in the bibliometric study of DIGITALIZATION as it helps to analyze the important issues in the topic, future direction of trends and developing areas of the study. There are some keywords that may provide information related to important problems in the research papers considering investigation priority topics. By assessing the number along with links of key phrases, researchers are able to obtain which ideas control the field of study, track the development of study and find shortcomings in the study within the vast collection of research papers.



**Figure:1 Keyword Analysis**

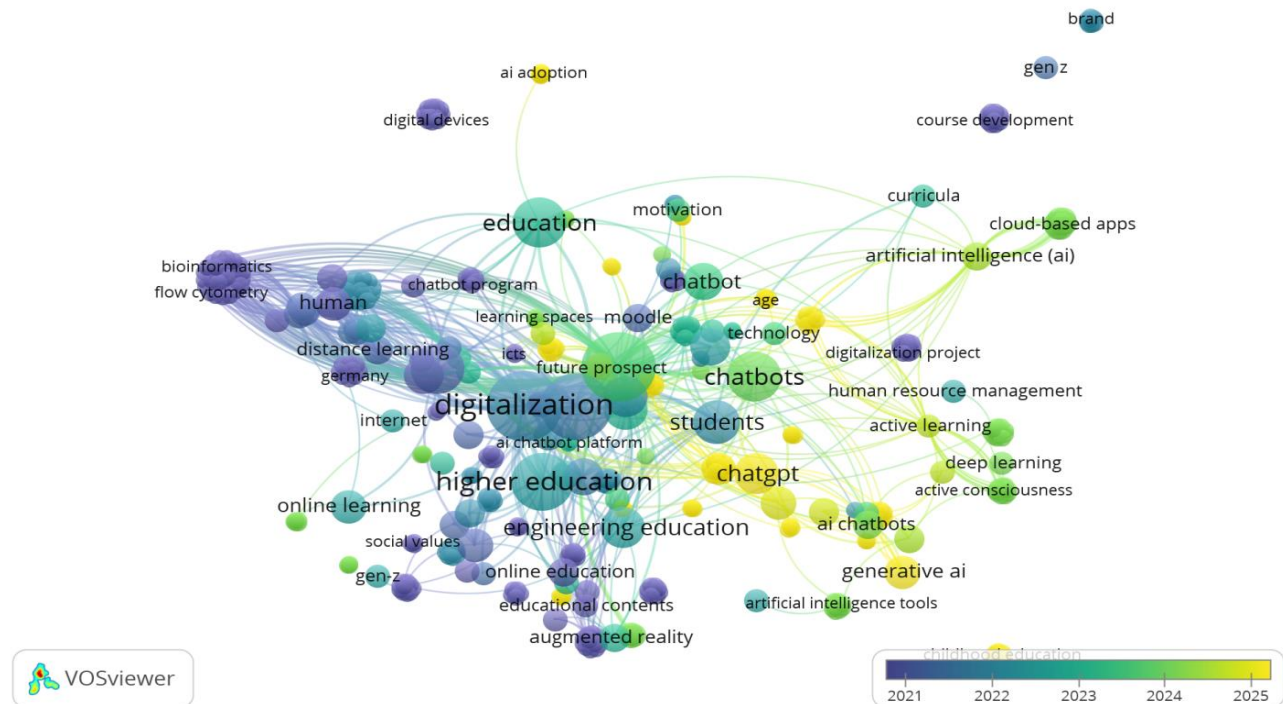


**Table: 1 Keyword Analysis**

| Cluster  | Keywords                                                                    | Focus area                                                 | Approx No. of keywords |
|----------|-----------------------------------------------------------------------------|------------------------------------------------------------|------------------------|
| Cluster1 | Digitalization, higher education, e-learning, internet, distance learning   | Digital education systems and technology adaptation        | ~25                    |
| Cluster2 | Chatbots, education, students, motivation                                   | Educational use of chatbots and AI for learning engagement | ~20                    |
| Cluster3 | Chatgpt, generative AI, AI chatbots, artificial intelligence, high learning | Emerging AI and generative tools integration               | ~15                    |
| Cluster4 | Gen-Z, course development, social values                                    | Sociocultural & generational aspects of digital education  | ~10                    |



The transformation of research themes from 2021 to 2025 in the field of education and AI is shown in the bibliometric map generated by using VOSviewer. The earlier research (2021-2022) mainly focuses on digitalization, e-learning and higher education while mid-phase study (2023) emphasizes chatbots, student engagement and e-learning tools. In recent years (2024-2025) trending topics like ChatGPT, generative AI, deep learning and AI-based applications have gained significant importance. The most frequently used keywords are digitalization, chatbots, higher education, ChatGPT, efficient learning, student engagement, artificial intelligence and Gen-Z students, indicates a strong shifting from traditional chalkboards systems towards digital learning, AI-driven and personalized educational tools. In conclusion, the map shows how academic focus has been transformed from traditional chalkboard learning to the advanced generative AI technologies in education.

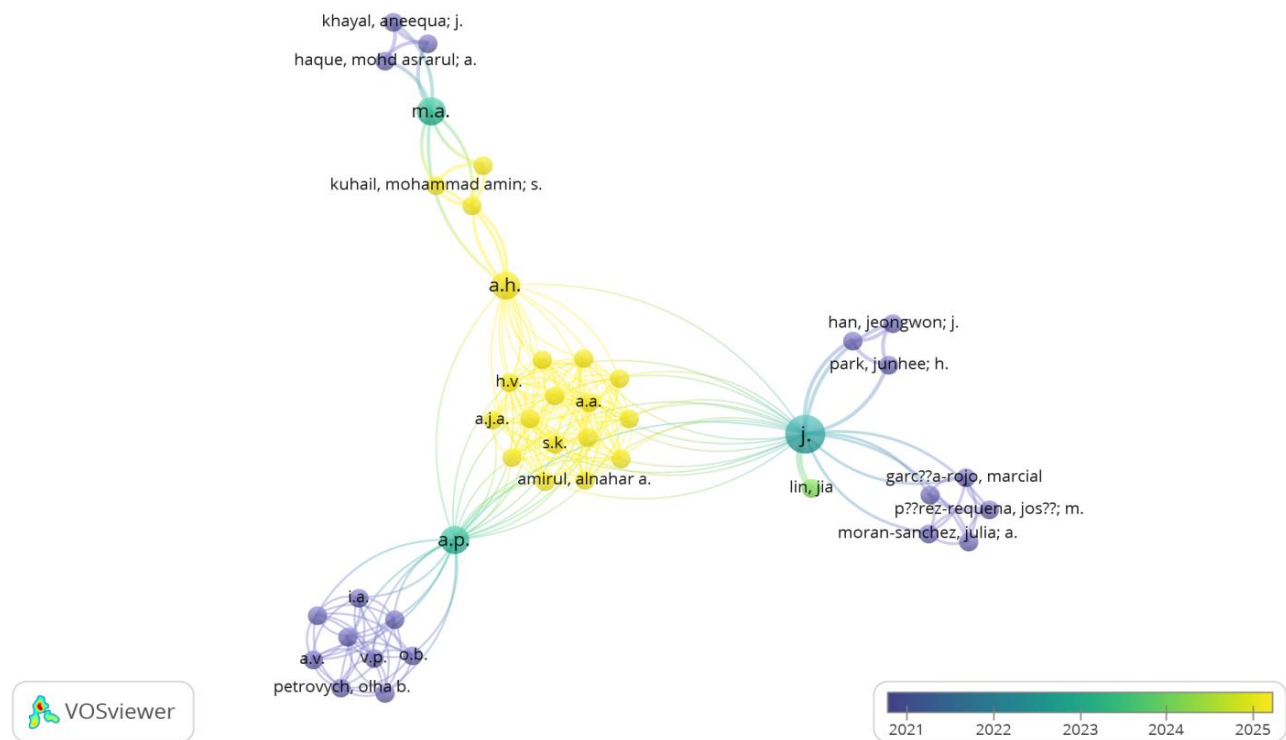
### **Co-occurrence Author keywords**

Many well-known researchers have all come together as essential contributors to digital education and AI-based learning. Their work mainly focuses on chatbot design, interactive learning techniques and Gen-Z student's efficient learning in educational field. These authors have set a vital role in reshaping the foundations and AI-driven technology in education.

The analysis of author keywords shows that the transformation from traditional teaching systems to AI-based education systems is not achieved by independent efforts but with the combined contributions of globally interconnected groups of researchers. The analysis of co-authorship also emphasizes the expanding collaboration between academia and business, especially with innovative companies and educational startups financing in AI-based platforms. The combined study of these authors has constructed a very strong foundation for the future of smart learning. This shows how new creative ideas, digital teaching methods and innovation can come together to make learning experiences more effective, customized for each student and accessible to everyone.



**Figure: 2 Co-occurrence Author keywords**



### CLUSTER 1: Blue

- Keywords: digitalization, higher education, online education, distance learning, internet
- Theme: Early studies (2021-2022) focus on the digital evolution of education, especially after COVID-19 when institutions combined technology and education together.
- Focus area: Researchers highlight the framework and accessibility of digital learning.

### CLUSTER 2: Green

- Keywords: education, chatbots, students, motivation
- Theme: Mid-phase studies (2022-2023) where authors explained the use of AI chatbots in education – aiming on the student interaction, motivation and communication.
- Focus area: AI design, chatbot programs, evaluating students.

### CLUSTER 3: Yellow

- Keywords: chatgpt, AI chatbots, generative AI, artificial intelligence, deep learning
- Theme: Recent trends (2023-2025) elaboration of ChatGPT and generative AI studies.
- Focus area: AI-based teaching, customized education, e-learning, chatgpt.

**CLUSTER 4: Purple**

- Keywords: digital devices, Gen-Z, course development
- Theme: Small group of author's aims on Gen-Z's learning behavior, AI tools, digitalization in education.
- Focus area: Combining technology with education.

**Table: 2 Co-occurrence Author keywords**

| YEAR      | COLOR  | FOCUS                                    | KEYWORDS                                            |
|-----------|--------|------------------------------------------|-----------------------------------------------------|
| 2021-2022 | Blue   | Early digitalization, online learning    | Digitalization, distance learning, online education |
| 2022-2023 | Green  | Chatbots integration in higher education | Chatbot, students, education                        |
| 2023-2025 | Yellow | Generative AI & ChatGPT                  | Chatgpt, AI chatbots, generative AI, deep learning  |

**Contribution of AI-driven Nation-wise**

Research analysis of county-wise distribution emphasizes that the AI-based education is not evenly spread across the world. Developed countries such as USA, UK, Germany and Japan leads this field as they have better access to futuristic technologies, strong research investments and well-established educational frameworks.

On contrast, developing countries like India, Malaysia and Brazil are providing significant development. These countries positively combining AI technologies, including chatbots and virtual learning tools, into classrooms and online learning platforms. In conclusion, this trend explains that the need for AI-driving is globally based. It is not just advanced countries that benefit the most. Nations worldwide recognize the importance of digital learning tools to enhance the quality of education, customized learning experiences and make education more interactive and accessible.



**Figure: 3 Contribution of AI-driven Nation-wise**

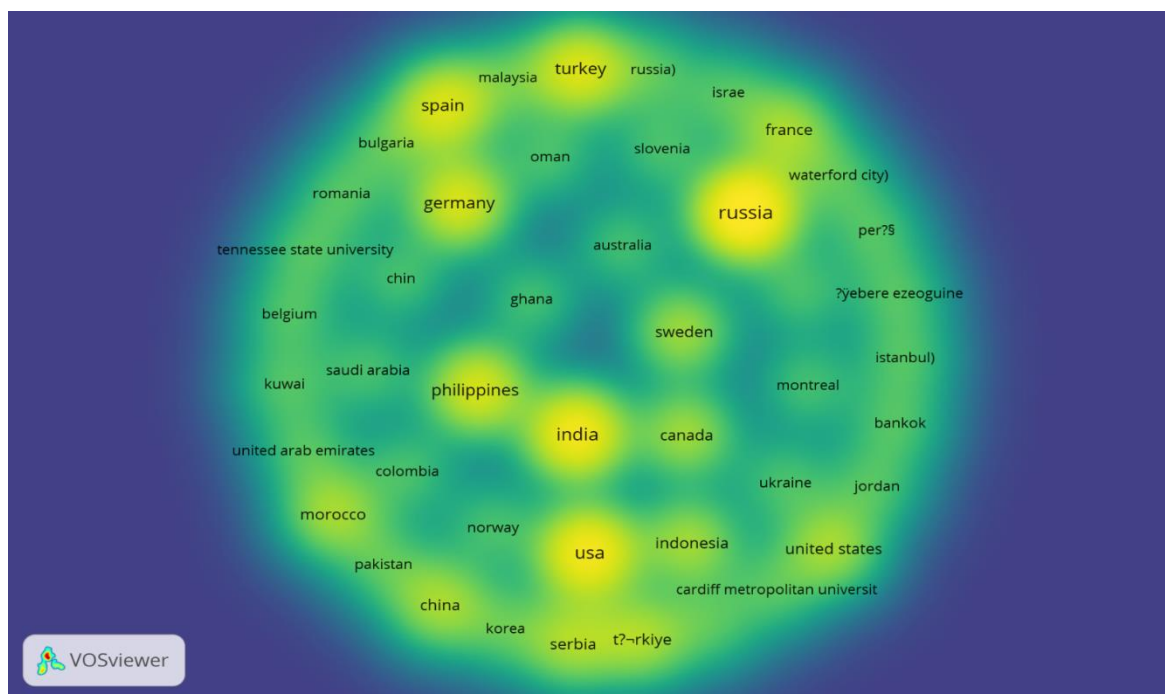


**Table: 3 Contribution of AI-driven Nation-wise**

| Activity level                                   | Countries                                                | Research Implication         |
|--------------------------------------------------|----------------------------------------------------------|------------------------------|
| High-Activity Countries<br>(Bright Yellow Zones) | India, USA, Russia, Spain, Turkey, Philippines, Germany. | Major contributor's country. |
| Moderate-Activity Countries<br>(Green Zones)     | France, China, Indonesia, UAE, Sweden, Canada.           | Growing involvement.         |
| Low-Activity Countries<br>(Blue-Green Zones)     | Oman, Norway, Kuwait, Ghana, Jordan.                     | Limited publications.        |

The bibliometric density map shows that India, USA, Russia, Spain, Turkey, Germany, and the Philippines are the major contributors with the highest research activity. Countries like China, France, Indonesia and Canada show moderate participation, while in Jordon, Ghana, Kuwait and Norway have lower involvement. Overall, the map highlights that Asia and Europe dominates the research output, while Middle East and Africa shows emerging contributions.

### Author Overlay Visualisation

The VOSviewer cover illustrations that shows the progressive distribution of authors who have contributed to studies on digitalization, artificial intelligence, chatbots and Generation Z learning.



In this map, each node represents an individual author, with the colour indicating the average publishing year. The colour gradient runs from dark blue 2021 to yellow 2025, allowing for the identification of research trends and their transformation over time.

The image shows that the first studies, indicated by dark blue nodes, were largely concerned with digital transformation, online learning and the implementation of educational technologies in higher education. During this time, authors like Michael Herczeg (2021) and other early contributors set the groundwork for understanding how digitalization affects teaching and learning methods.

The green colored nodes, which reflect publications from 2023-2024, show a shift towards the use of artificial intelligence in education. This period saw an increase in research on AI-powered learning systems, chatbot-assisted education, student engagement, digital literacy and personalized learning. Several authors, including Elena Frolova (2024), Urban Žiž (2024), Ulla (2024) and Bressane et al. (2024) have made major contributions to research in these fields. The most recent publications, indicated in yellow, are those published in 2025. These works concentrate on advanced subjects such as Generative Artificial Intelligence, ChatGPT, intelligent tutoring systems, AI-assisted academic writing, adaptive learning environments and human-AI interactions. The abundance of yellow nodes reflects the rapid expansion of research into generative AI technologies and its applications in higher education.

Overall, the covered illustration displays a significant shift in research trends from digital learning and technology integration to advanced artificial intelligence applications in education. The development of publication years demonstrates that research is increasingly focused on intelligent educational systems that can improve individualized learning, academic engagement and efficiency for Generation Z students. These findings show that AI-powered educational technology will continue to influence future research and practice in digital education.

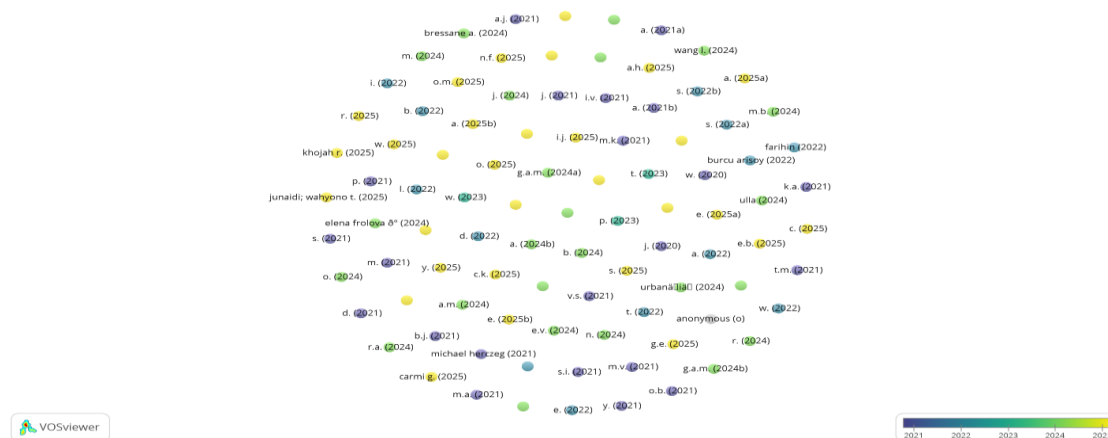


Figure: 4 Overlay Visualization of Authors



**Table: 4 Overlay Visualization of Authors**

| Publication Period | Colour     | Major Research Focus                                                                          | Representative Authors                                                      |
|--------------------|------------|-----------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------|
| 2021               | Dark Blue  | Digital transformation, online learning, higher education                                     | Michael Herczeg (2021), A.J. (2021), T.M. (2021)                            |
| 2022               | Light Blue | Digital education, e-learning, technology adoption                                            | Burcu Arisoy (2022), Farihin (2022), I. (2022)                              |
| 2023–2024          | Green      | Artificial intelligence, chatbot-assisted learning, personalized learning, student engagement | Elena Frolova (2024), Urban Žiž (2024), Ulla (2024), Bressane et al. (2024) |
| 2025               | Yellow     | Generative AI, ChatGPT, intelligent tutoring systems, AI-supported learning                   | Emerging researchers (2025 publications)                                    |

## Key Findings

The cover illustration displays the progressive transformation of research in digital education and artificial intelligence between 2021 and 2025. Early studies primarily focused on digital transformation and online learning whereas research published from 2023 onwards increasingly explored artificial intelligence, chatbot-assisted education and personalized learning environments. The dominance of yellow nodes in the illustration indicates that Generative AI, ChatGPT, intelligent tutoring systems and AI-assisted learning have emerged as the most active and rapidly growing research areas in recent years. Overall, the analysis confirms a significant transition from traditional digital learning approaches to intelligent AI-driven educational systems that aim to improve student engagement, learning efficiency and the educational experiences of Generation Z learners.

Author Cover Illustration Generated with VOSviewer (2021-2025). The color gradient indicates the average publication year, from dark blue 2021 to yellow 2025, indicating the worldly evolution of research on digitalization, artificial intelligence, chatbot-assisted learning and Generation Z education.

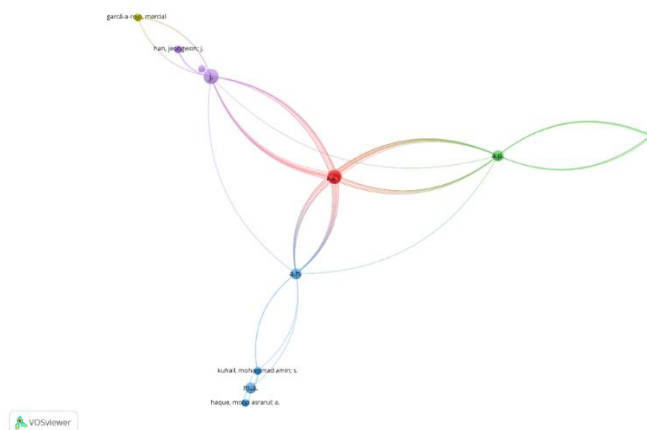
## Co-authorship Analysis of Authors

VOSviewer was used to analyze co-authorship ties among writers who contributed to studies on digitalization, artificial intelligence, chatbots and generation Z learning. In the network representation, each node represents each author, with the size of the node indicating the author's

The green cluster, led by A.P., displays collaboration in research on artificial intelligence applications, digital learning technology and educational innovation. The significant correlation between the red and green clusters shows active collaboration among researchers working on AI-supported educational systems.

Another joint research group studying digital learning environments and educational technologies is represented by the purple cluster centered around J. This cluster retains strong ties to the center red cluster, indicating ongoing knowledge sharing among academics. A smaller yellow cluster, comprising authors like Marcial García-Arojo, represents new relationships that complement the bigger research network.

Overall, the co-authorship network reveals a well-established pattern of worldwide collaboration among researchers. The extensive links across clusters suggest that research on digital education, artificial intelligence and chatbot-assisted learning is becoming more collaborative and integrative. Such partnership has shift the creation of innovative educational technology and contributed to the expanding body of information on AI-powered learning environments for Generation Z students.



### Figure: 5 Co-authorship Analysis of Authors



**Table: 5 Coauthorship Analysis of Authors**

| Cluster                   | Representative Authors                         | Primary Research Area                                                         | Interpretation                                                                        |
|---------------------------|------------------------------------------------|-------------------------------------------------------------------------------|---------------------------------------------------------------------------------------|
| <b>Cluster 1 (Red)</b>    | A.A.                                           | Digital education, AI integration, interdisciplinary collaboration            | Serves as the central collaboration hub connecting multiple research groups.          |
| <b>Cluster 2 (Green)</b>  | A.P., A.V.                                     | Artificial intelligence, intelligent learning systems, educational innovation | Focuses on AI-driven educational technologies and digital transformation.             |
| <b>Cluster 3 (Blue)</b>   | A.H., Mohammad Amin Kuhail, Mohd Asrarul Haque | Chatbot-assisted learning, educational technology, student engagement         | Focuses on AI-driven educational technologies and digital transformation.             |
| <b>Cluster 4 (Purple)</b> | J., Han Jeongwon                               | Digital learning environments, AI-supported teaching                          | Examine the educational applications of conversational AI and digital learning tools. |
| <b>Cluster 5 (Yellow)</b> | Marcial García-Arojo                           | Emerging AI applications in education                                         | Represents collaborative research on technology-enhanced learning practices.          |

## Key Findings

This analysis emphasizes how a research on digital education and AI is collective. The network is split up into several interconnected research clusters, with A.A. acting as the main hub for collaboration amongst different author groups. Strong bonds are formed between researchers focusing on educational innovation, chatbot-assisted learning, and artificial intelligence. Additionally, the analysis reveals a rise in global cooperation, which has facilitated the advancement of multidisciplinary research on AI-supported learning environments. Overall, the results show that cooperative research networks have been crucial in expanding our understanding of digital transformation and AI-driven education, especially in improving the educational opportunities for Generation Z students.



VOSviewer was used to generate the co-authorship network of writers. The network demonstrates the cooperative connections between writers in the fields of chatbot-assisted learning, artificial intelligence, and digital education. Author productivity is represented by node size, the amount of collaboration is shown by connection strength, and diverse collaborative research clusters are represented by different colors.

## **Discussion**

### **Finding**

The reviewed literature suggests that digitalization increases Gen Z's academic productivity by providing flexible AI-based learning, virtual classrooms, improved resource access, and self-directed learning environment, etc. Although there are some problems occurring such as excessive screen time and distractions, uneven access of resources and weak internet, etc. But it can all be taken care of by providing encouragement about digital wellbeing education, interactive learning methods and supportive digital education policies. Overall, digitalization in education is bringing the world to flexible and collective learning environments. This transformation highlights the combined revolution of technology and education in improving the learning efficiency and engagement of the Gen Z students.

### **Conclusion**

This study shows how Gen-Z's academic learning and engagement has been reconstructed through digital transformation with the help of AI tools, e learning platforms, etc. There has been significant enhancement in learning and productivity in Gen-Z's students' academics with less distraction or excessive use of technology with the help of combined and balanced mixture of traditional and digital methods. Therefore, in conclusion, digitalization has evolved education into a collective and customized process for Gen Z students which helps in reshaping and rebuilding the education system. It provides a remarkable improvement in the learning experience and academic productivity of the students.

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