WORLD JOURNAL OF PHARMACY AND PHARMACEUTICAL RESEARCH

Research Article

2025
Volume: 02
Issue: 04
Page: 174-191

AI-BASED EDUCATIONAL CONTENT DELIVERY IN PODCASTING: A COMPARATIVE AUDIENCE ENGAGEMENT ANALYSIS

Ferguson D.[1] and Hailemeskel B.[2]*

[1]MSc, Doctor of Pharmacy Student; [2]B. Pharm, MSc, Pharm.D., RPh.

School of Pharmacy, Howard University.

Received: 10 March 2025 **Revised: 29 March 2025** **Accepted: 18 April 2025**

Corresponding Author: Hailemeskel B.

Address: 2300 4th Street, NW, Washington, DC 20056.

ABSTRACT

INTRODUCTION: This study explores the impact of artificial intelligence (AI) integration in educational podcasts on global audience engagement, comparing two formats: The New Chemist Podcast (TNCP), which incorporates AI features such as personalized content and multilingual translation, and Lecture-casts (LCP), which follow a traditional lecture-style format with minimal AI use. AI technologies in education, including adaptive learning systems, chatbots, virtual tutors, and automated assessment tools, are transforming the landscape of digital learning by enhancing personalization, feedback immediacy, and scalability. TNCP utilizes these tools to tailor episodes, boost clarity, and dynamically adjust content based on user needs, whereas LCP provides a more consistent, structured experience. **METHODS:** Data from Apple Podcasts and Listen Notes rankings from March 2024 to March 2025 were analyzed to assess listener engagement across multiple countries. TNCP showed strong upward momentum, particularly in regions such as India, Mauritania, and Slovakia, driven by AI-enhanced features. Although LCP had a higher total listener count (625 vs. 348), TNCP achieved significantly higher average listening time per user (22.9 vs. 15.5 minutes, $p < 0.05$), reflecting deeper user engagement. Additionally, TNCP ranked in the top 10% globally, underscoring its international appeal. **RESULTS:** Country-specific data further illustrated these trends: TNCP excelled in nations seeking modernized, personalized learning experiences, while LCP maintained dominance in areas with a preference for traditional lecture methods, such as Albania and Canada. A comparative framework also

evaluated the two systems on criteria such as personalization, feedback, scalability, equity, and data privacy. AI-driven systems outperformed traditional methods in most dimensions but raised concerns around data privacy and digital access. **CONCLUSION:** The findings emphasize the growing importance of AI in making education more accessible, engaging, and globally effective. As digital education continues to evolve, hybrid approaches blending AI-enhanced interactivity with structured content may become the standard for global educational delivery.

KEYWORDS: Artificial Intelligence (AI), Educational Podcasts, Global Audience Engagement, TNCP, LCP, Adaptive Learning Systems, Virtual Tutors, Chatbots, Automated Assessment Tools, Personalized Learning, Multilingual Translation, Feedback Immediacy, Scalability, Digital Learning, Traditional Lecture Format, Apple Podcasts Rankings, Listen Notes, Data Privacy, Equity of Access, Hybrid Educational Models.

BACKGROUND - ARTIFICIAL INTELLIGENCE TECHNOLOGIES AND THEIR ROLE IN MODERN EDUCATION

Artificial Intelligence (AI) is reshaping the way education is delivered, particularly through digital platforms like podcasts. The integration of AI technologies has made educational content more personalized, engaging, and globally accessible, marking a significant departure from conventional teaching models. When we say AI technologies, it includes different modes of technology. Some of them are listed below.

Podcasts

Podcasts are digital audio programs available for streaming or download and are often released in episodes. They cover a range of subjects—including education, science, storytelling, news, and commentary—and can be accessed via platforms like Apple Podcasts, Spotify, or Google Podcasts. Primarily audio-based and convenient for on-the-go learning, podcasts are increasingly recognized as powerful educational tools.

The infusion of AI into podcasting has revolutionized the development and delivery of content. Technologies such as machine learning, natural language processing, and adaptive learning systems are being used to enhance voice clarity, translate episodes into multiple languages, personalize the learning path, and adjust delivery based on individual learner behavior. These features allow podcasts to evolve from static, one-size-fits-all formats to dynamic, learner-responsive environments.

Two educational podcast formats exemplify this transformation are (1) **The New Chemist Podcast (TNCP)** integrates AI features like multilingual translation, personalized voice options, and AI-generated scripts. It presents chemistry and science content through interviews with experts, interactive narratives, and audience-tailored segments. TNCP aims to make science more accessible and engaging for diverse learners around the world and (2) **Lecture-casts (LCP)** represent a more traditional approach, delivering pre-recorded classroom-style lectures with minimal AI involvement. While some LCP episodes may utilize basic translation tools, their content remains largely linear and standardized, catering to learners who prefer structured, instructor-led delivery.

Machine Learning Algorithms

Machine learning (ML) is a subset of AI that enables computers to learn patterns from data and make predictions or decisions without being explicitly programmed (Jordan & Mitchell, 2015). In educational settings, ML algorithms analyze vast amounts of student performance data to identify learning gaps, forecast academic outcomes, and tailor instructional strategies to individual needs. For example, learning management systems may track students' quiz results, time on task, and participation metrics to provide personalized learning pathways (Zawacki-Richter et al., 2019).

Adaptive Learning Systems

Adaptive learning systems are AI-powered platforms that dynamically adjust lesson content, pacing, and difficulty in response to real-time learner behavior and performance (VanLehn, 2011). Platforms such as Squirrel AI and Knewton use adaptive algorithms to support students from diverse backgrounds by providing customized instruction, thus reducing achievement gaps. These systems have been especially effective in large-scale learning environments by maintaining engagement and improving mastery through continuous feedback and re-calibration of content delivery (Holmes et al., 2019).

Natural Language Processing and Chatbots

Natural Language Processing (NLP) is a branch of AI that allows computers to understand, interpret, and generate human language (Cambria & White, 2014). NLP powers chatbots that serve as on-demand learning assistants, capable of answering questions, providing explanations, and offering hints during assignments. These tools are available 24/7, which enhances access to support outside classroom hours, particularly for distance or non-traditional learners (Winkler & Söllner, 2018).

Virtual Tutors and Intelligent Agents

Virtual tutors are AI-driven agents designed to simulate a human teacher's interactions, offering instructional support and motivation (Graesser et al., 2005). A notable example is "Jill Watson," a virtual teaching assistant developed at Georgia Tech using IBM's Watson platform. Jill was integrated into an online course and responded to students' questions with such accuracy that many students did not realize they were interacting with an AI. These agents enhance learning by extending instructor presence, promoting engagement, and reducing the cognitive load on educators (Goel & Polepeddi, 2016).

Automated Assessment Tools

AI-powered assessment tools use algorithms to automatically evaluate students' written, multiple-choice, and spoken responses. These tools provide immediate, consistent, and scalable feedback, which not only reduces instructor workload but also supports formative assessment practices. AI systems are now capable of evaluating short essays, detecting plagiarism, and offering constructive feedback on grammar, structure, and content relevance (Balfour, 2013; Ullman et al., 2020).

Learning Analytics and Predictive Modeling

Learning analytics refers to the collection, measurement, and analysis of student data to optimize learning outcomes (Siemens & Long, 2011). AI-driven learning analytics enable institutions to identify at-risk students, predict academic success, and intervene early with targeted support strategies. These insights empower educators and administrators to make data-informed decisions that improve course design and resource allocation.

These AI-enhanced strategies are not only improving access and efficiency but also deepening learner engagement—a critical determinant of educational success. Traditional instructional models often lack interactivity and real-time responsiveness, which can result in lower retention and motivation. In contrast, AI-enabled approaches foster higher engagement through adaptive feedback, personalized content, and immersive learner experiences (VanLehn, 2011; Chen et al., 2020; UNESCO, 2021).

Ultimately, the fusion of podcasting and AI represents a paradigm shift in education—moving toward systems that are not only scalable and efficient but also inclusive and learner-centered. As more institutions and educators adopt these innovations, educational podcasts stand poised to become a cornerstone of modern digital learning.

In the last decade, multiple global studies have shown that AI can significantly enhance educational podcasting by personalizing audio content, automating production, improving accessibility, and analyzing learner engagement (Jafarian & Kramer, 2025). Findings suggest that AI-driven features increase motivation, language proficiency, and interest among learners, while also enabling multilingual expansions to bridge global knowledge gaps (Do et al., 2024; Baskara et al., 2024).

STUDIES ON AI-ENHANCED EDUCATION AND GLOBAL DIGITAL ENGAGEMENT

Several recent studies have examined the role of AI-driven educational tools in enhancing learner engagement, retention, and accessibility—particularly in global and digital learning environments. These studies collectively reinforce the growing consensus that AI technologies have the potential to transform the learner experience by personalizing content delivery and expanding international reach.

A 2019 systematic review by Zawacki-Richter et al. analyzed 146 peer-reviewed studies on artificial intelligence applications in higher education. The authors concluded that AI-supported personalization, including adaptive learning pathways, language translation, and intelligent tutoring, significantly improved student engagement, particularly in cross-border, digital environments (Zawacki-Richter et al., 2019). This aligns with the objectives of the present study, which evaluates whether AI-enhanced podcast features improve audience metrics across countries.

Similarly, Chen et al. (2020) explored how AI-integrated MOOCs (Massive Open Online Courses) influenced user behavior. The research demonstrated that AI features such as voice recognition, real-time feedback, and automated translations were positively associated with increased user participation and content retention, especially among learners from non-English-speaking backgrounds. These findings support the hypothesis that linguistic accessibility—enabled by AI—is a major driver of international digital learning engagement.

In another comparative study, Holmes et al. (2019) highlighted that AI-enhanced educational platforms outperformed traditional learning environments in learner motivation and satisfaction. The study emphasized that adaptive and interactive content, powered by machine learning, can better capture and sustain learners' attention compared to passive formats like traditional lectures.

A global experiment conducted by EdSurge (2021) evaluated the impact of AI-driven learning apps in low- and middle-income countries. It found that audio-based AI content (e.g., podcasts with local language support and tailored pacing) achieved higher listening completion rates and learner persistence, especially in regions with limited access to visual platforms or broadband infrastructure. These results underscore the importance of modality and cultural-linguistic adaptability in scaling digital education internationally.

Moreover, Winkler and Söllner (2018) examined the use of AI chatbots and voice assistants in digital courses. Their study found that conversational AI tools led to increased course retention rates and message responsiveness, suggesting that even minimal AI integration into content delivery (e.g., voice personalization, interactive Q&A features) significantly improves learner interaction.

Despite these developments, few studies have explicitly compared AI-enhanced audio education formats (like podcasts) with traditional lecture-based audio across diverse global audiences. This research therefore aims to fill a critical gap by providing comparative metrics—such as listener retention, audience growth, and regional distribution—between two podcast formats that differ in their integration of AI technologies.

The primary goal of this study is to assess the impact of AI-based educational strategies on audience engagement in digital learning across different countries globally. Specifically, the study compares two podcast formats—TNCP, which incorporates AI-driven features such as personalized content, voice enhancements, and language translations, and LCP, which follow a more traditional lecture-style approach with minimal AI involvement. By measuring and analyzing audience engagement across various countries and regions worldwide, this research aims to determine whether AI-enhanced educational content results in higher levels of listener interaction, retention, and global reach compared to standard, lecture-based methods. The findings are intended to provide insights into the effectiveness of modern, adaptive learning tools in improving digital education outcomes on a global scale.

METHODS

Over the years, multiple podcasts both in the form of LCP and TNCP were posted by the research team on various topics related to chemistry. The podcast uses traditional interviewing techniques and advanced AI technology in some podcast introductions and

linguistic translations, to make learning more engaging and personalized for listeners. It adjusts content based on what learners need and provides interactive educational experiences.

LCPs are traditional educational recordings that follow a standard lecture format, similar to a professor giving a lecture in class with some AI integration for translation purposes. These do not use AI or interactive elements, making them less adaptable to individual learning needs. In simple terms, TNCP is a smart, partially AI-powered learning podcast, while Lecture-casts are regular, recorded lectures without interactive or personalized features and some AI integration for linguistic translation purposes.

This analysis compares TNCP, which uses AI to teach, and Lecture-casts, which use traditional teaching methods, both podcasts are being compared based on their rankings on Apple Podcasts. The study examines how AI-enhanced educational content affects engagement and dissemination compared to conventional formats.

The research conducted a quantitative analysis of publicly accessible Apple Podcast rankings from March 2024 to March 2025, segmented monthly and geographically. Engagement attributable to AI integration was assessed using comparative analyses.

For this study the engagement was determined using publicly available rankings which are based on audience consumption of at least 60 seconds or more to the podcast episode. Moreover, engagement can manifest in various ways, such as participation in discussions, completion of interactive exercises, and responsiveness to adaptive learning cues. Higher engagement levels are associated with better comprehension, increased motivation, and improved knowledge retention, making it a critical factor in evaluating educational effectiveness. For this study since the data is publicly available there was no need to seek for an ethical clearance for this research was granted by an Institutional Review Board (IRB).

RESULTS

The listener engagement data reveal significant differences between the two educational podcast formats - LCP and TNCP, in several categories between as shown below.

Listening Scores

Figure illustrates listener engagement by episode from September 2022 through March 2025. The series accumulated a total of 625 listeners, with a noticeable peak occurring around February 2023, when episodes reached their highest engagement of approximately 60–65

listeners. Following this peak, there was a sharp decline in March 2023, dropping to about 25 listeners per episode. Throughout the remainder of 2023 and into 2024, listener numbers fluctuated with minor rebounds during the summer and fall, but the overall trend showed a gradual decline. By early 2025, engagement had fallen significantly, with listener counts dropping to fewer than 10 per episode in March. This downward trend suggests a waning interest in the series, indicating the potential need for renewed promotional efforts, updated content, or enhanced strategies to re-engage the audience.

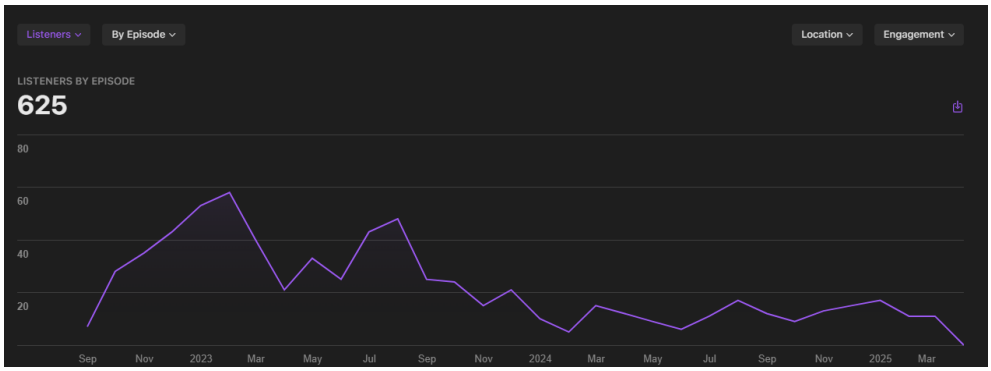


Figure 1: Lecture-Casts Listener Trends (Sept 2022–March 2025).

In contrast, as shown in Figure 2, TNCP gained a total of 348 listeners over the same period. Although initial engagement was lower, the podcast showed a consistent upward trend starting mid-2024, peaking in early 2025. This surge appears to be driven by the integration of AI-enhanced features such as personalization, multilingual support, and adaptive content delivery.

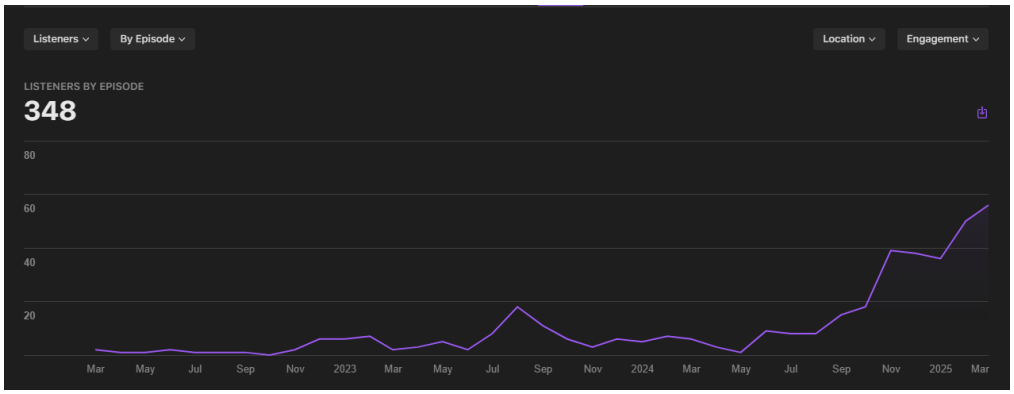


Figure 2: TNCP Listener Growth (March 2022–March 2025).

Platform Rankings and Global Visibility

Additional performance metrics from Listen Notes revealed that TNCP achieved a Listen Score (LS) of 24, placing it in the top 10% of over 3.5 million podcasts worldwide. This

metric—based on aggregated monthly listening data—highlights TNCP's significant international reach.

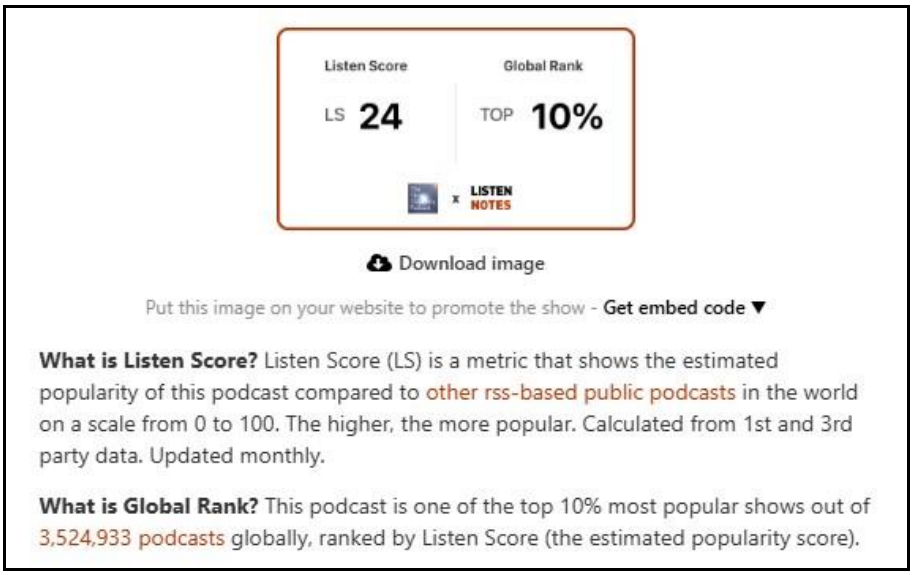


Figure 3: TNCP Listen Score Ranking.

Taken together, these findings underscore the unique value propositions of each podcast: TNCP leverages personalization and innovation to capture a wide global audience seeking dynamic, AI-powered education, while LCP's consistent lecture model proves equally appealing to listeners who favor or require a more systematic approach. Over time, the continuing evolution of these patterns—particularly if hybrid methods emerge that blend AI interactivity with structured lectures—may further reshape global podcast rankings and set new expectations for educational content delivery in a rapidly changing digital landscape.

The analysis strongly suggests AI-driven podcast methodologies, as evidenced by TNCP's rankings in diverse global regions, significantly enhance audience engagement compared to traditional lecture-based podcasts. This effectiveness is particularly pronounced in regions where traditional educational resources are scarce, reinforcing the importance of adaptive, personalized educational solutions (UNESCO, 2021; Baker & Inventado, 2014). However, the sustained success of LCP in certain contexts demonstrates that traditional instructional methods remain valuable for audiences prioritizing structured and consistent educational content (Luckin et al., 2016; Mayer, 2009).

Country-by-Country Comparative Analysis

Comparative analysis of podcast rankings for "The New Chemist Podcast" and "Lecture-casts" across various countries, based on Apple Podcasts' Chemistry category from March 2024 to March 2025 (Figure 4). Rankings indicate relative audience engagement, with lower numbers signifying higher positions and greater engagement. Notably, "The New Chemist Podcast" achieves higher rankings in several countries such as Mauritania, Slovakia, and India, suggesting significant global appeal due to AI-integrated content. Conversely, "Lecture-casts" demonstrates stronger engagement in Albania, Austria, and Canada, indicating a preference for traditional lecture formats in certain regions.

The overall effect across all countries suggests that AI-driven educational content generally enhances podcast visibility and performance, though the strength of this effect varies by region. This indicates that AI integration could be one of the key factors in improving educational content reach, particularly in Africa and Asia, while its influence may be less pronounced in some Western markets. As shown, in the United Kingdom, the impact was moderate, indicating that while AI still contributed to improved rankings, other factors may also play a role in audience engagement.

The significant positive correlation of AI-driven content in regions such as Kenya, Tunisia, and Vietnam support the effectiveness of personalized, adaptive learning experiences in overcoming educational barriers and enhancing global engagement (VanLehn, 2011; OECD, 2020). Lecture-casts, utilizing traditional methods, performed well in regions such as Albania and the United Kingdom, underscoring the continued relevance of structured and uniform educational approaches (Chen et al., 2020; Mayer, 2009).

On the other hand, TNCP is very popular in some countries, performing especially well in Mauritania, Slovakia, and India. However, LCP is ranked higher in many places, including Albania, Austria, and Canada. On the other hand, TNCP does much better than LCP in Australia, Spain, and the United Kingdom. In some countries, their rankings are very close, like in France and Taiwan. In the United States, TNCP is ahead of LCP, but both are ranked lower compared to other regions.

From a country-by-country perspective, TNCP has a strong presence in Mauritania, Slovakia, India, Italy, and Spain, where it consistently outperforms LCP. On the other hand, LCP dominates in Albania, Austria, and Canada, where it holds better rankings than TNCP. Certain

countries, such as France and Taiwan, show a balanced performance between the two, while others exhibit significant gaps, with TNCP leading in Australia, Spain, the UK, and the U.S. The fact that TNCP ranked in places like Canada, Australia, and the UK, while LCP did not as much, suggests that AI-driven educational content may be more engaging and appealing to a global audience. Overall, this means that TNCP's approach is helping it reach and attract more listeners worldwide compared to mostly traditional methods used in Lecture-casts.

The fact that TNCP ranked in places like Canada, Australia, and the UK, while Lecture-casts did not, suggests that AI-driven educational content may be more engaging and appealing to a global audience. Overall, this means that TNCP's approach is helping it reach and attract more listeners worldwide compared to traditional methods used in Lecture-casts.

The significant positive correlation of AI-driven content in regions such as Kenya, Tunisia, and Vietnam supports the effectiveness of personalized, adaptive learning experiences in overcoming educational barriers and enhancing global engagement (VanLehn, 2011; OECD, 2020). Lecture-casts, utilizing mainly traditional methods, performed well in regions such as Albania and the United Kingdom, underscoring the continued relevance of structured and uniform educational approaches (Chen et al., 2020; Mayer, 2009).

This result presents a detailed comparison between TNCP and LCP, focusing on listener engagement, growth trends, and statistical analysis over their operational history. The rankings also suggest that TNCP has a strong foothold in specific regions, particularly in India, Mauritania, and Slovakia, while LCP leads in many other countries like Albania and Canada. In some regions, their rankings are closely matched. This analysis provides insights into the global reach and popularity of both podcasts based on Apple Podcast rankings.

Figure 4: Global Podcast Rankings by Country (Apple Podcasts: March 2024–March 2025)

Comparative Country Rankings (TNCP vs. LCP)

Detailed comparative rankings of "The New Chemist Podcast" (TNCP) versus "Lecture-casts Podcast" (LCP) in the Apple Podcasts Chemistry category (March 2024–March 2025). Table 2 illustrates which podcast had superior performance in each listed country, with TNCP notably outperforming in countries such as India, Spain, and the United States, indicating the effectiveness of AI-driven, personalized educational content. LCP slightly leads in regions like Albania and Austria, suggesting sustained preferences for structured, lecture-based educational content in specific contexts.

Table 2: Comparative Analysis of Podcast Rankings by country (Apple Podcasts: March 2024–March 2025).

Country	TNCP Rank	LCP Rank	Superior Performance
Albania	3	1	LCP (slightly)
Australia	25	29	TNCP
Austria	25	22	LCP (slightly)
Canada	25	33	TNCP
France	49	47	Virtually equal
India	9	36	TNCP
Italy	19	24	TNCP
Mauritania	2	3	Both extremely high
Saudi Arabia	29	20	LCP
Slovakia	6	8	TNCP
Spain	24	56	TNCP
Taiwan	25	27	Virtually equal
United Kingdom	26	75	TNCP
United States	64	98	TNCP

Listener Engagement Metrics

Visual trends and quantitative metrics demonstrate that TNCP has significantly higher per-listener engagement and a strong growth trajectory, while LCP, despite early momentum, has experienced a decline in listenership (Table 3).

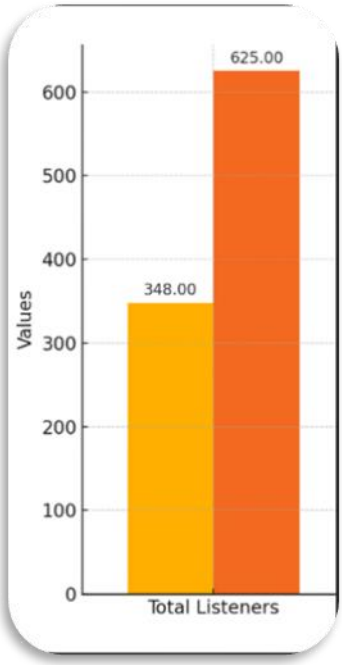
The comparative analysis between TNCP and LCP podcasts reveals notable differences in audience behavior and engagement. While LCP has a higher total number of listeners (625 vs. 348), TNCP outperforms in terms of average listening time per listener (22.9 minutes vs. 15.5 minutes). Statistical analysis confirms this difference is significant ($p < 0.05$), indicating that TNCP listeners engage more deeply with the content.

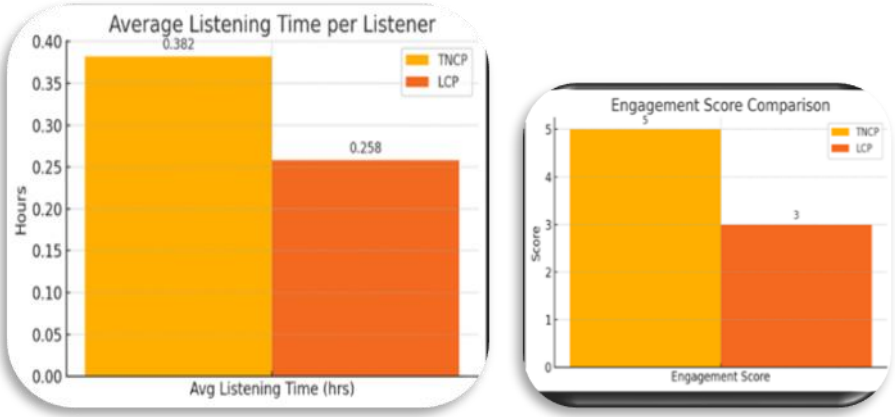
Trend analysis further highlights TNCP's upward momentum, with increasing listener counts peaking in early 2025, while LCP shows a clear downward trend in engagement since mid-2023. This suggests that TNCP is successfully retaining and growing its audience, while LCP may require strategic adjustments to regain listener interest.

Table 3: Listener engagement Comparison TNCP vs. LCP.

Metric	TNCP	LCP
• Total Listeners (All-Time)	348	625
• Total Listening Time	133 hours	203 hours
• Average Listening Time per Listener	0.382 hours (22.9 minutes)	0.258 hours (15.5 minutes)
• Engagement Efficiency	Longer, more consistent engagement per episode	Initial high engagement, now declining
• Trend (2024–2025)	Increasing listener counts, peaking early 2025	Declining engagement since mid-2023
• Growth Momentum	Strong and rising	Declining
• Statistical Significance (Average Listening Time per User)	Significantly higher ($p < 0.05$)	Lower engagement

This suggests that TNCP's content is not only more engaging per listener but also retaining and attracting users more effectively in recent months. The average listening times per user were compared with a two-sample t-test with p-value < 0.05, confirming that TNCP has significantly higher engagement per user.





Comparative Evaluation: AI vs. Traditional Methods

A thematic comparison of AI-driven versus traditional educational methods was conducted using key indicators: personalization, feedback immediacy, scalability, equity and accessibility, and data privacy. AI-based formats scored higher on adaptability, speed of feedback, and scalability, though they raised concerns about digital equity and data privacy. Traditional methods remained strong in consistency and reduced privacy risks but fell short in responsiveness and scalability.

Table 4: AI vs. Traditional Instruction—Key Criteria Comparison.

Criterion	AI-driven Methods	Traditional Methods
Personalization	High, dynamic adjustments	Low, standardized content
Feedback	Immediate, adaptive	Delayed, generalized
Scalability	High, uniform quality	Limited by teacher-student ratio
Equity & Access	Broad, digital divide risks	Local resource-dependent
Data & Privacy	Extensive analytics, privacy risks	Limited analytics, fewer risks

DISCUSSION

The comparative context of this study underscores the growing role of artificial intelligence (AI) in enhancing digital education, particularly through podcasting. Technologies such as intelligent tutoring systems and adaptive learning platforms significantly improve learner engagement by offering real-time, personalized feedback and tailored content delivery (VanLehn, 2011; Baker & Inventado, 2014; Holmes et al., 2019). These AI-based methods contrast with traditional educational approaches, which, although consistent and structured, often lack the adaptability needed for individualized learning experiences (Chen et al., 2020). Analysis of Apple Podcasts Chemistry category rankings across international markets reveals contrasting audience preferences for the two podcast formats. LCP, characterized by a standardized lecture approach, demonstrated exceptional performance in certain regions—

achieving the #1 ranking in Liberia and securing top-five positions in countries like Mauritania, Bhutan, Uganda, and the United Kingdom. These outcomes suggest that structured, traditional formats continue to resonate in contexts that value familiarity, order, and uniform instructional methods. This preference may also align with regional educational norms that favor predictable and authoritative teaching styles.

Conversely, TNCP maintained a strong competitive edge in key markets such as Mauritania, Slovakia, and India. Its success in these regions appears closely tied to its AI-driven format, which customizes content for diverse audiences through tools like multilingual translation and voice personalization. In areas where educational access is uneven or where learners seek greater interactivity, TNCP's adaptive model proved more engaging. The appeal of dynamic content delivery—especially in settings that lack access to traditional classroom structures—positions TNCP as a modern solution to long-standing educational gaps.

TNCP's global reach is further evidenced by its Listen Notes ranking, placing it in the top 10% of podcasts worldwide. High placements across African, European, and Asian countries suggest that AI-enhanced podcasts are not only scalable but also culturally adaptable. By meeting learners where they are—linguistically, cognitively, and geographically—TNCP exemplifies how technology can personalize education at scale.

Meanwhile, the continued relevance of LCP demonstrates that traditional, lecture-based models remain effective for audiences seeking dependable and formal instruction. The contrast between the two formats reinforces the need for flexible, hybrid educational models that blend the strengths of both approaches: the consistency and structure of traditional lectures with the responsiveness and personalization of AI-powered systems.

This study has several limitations that should be considered when interpreting the results. First, the analysis relied on publicly available podcast metrics from platforms such as Apple Podcasts and Listen Notes, which do not provide comprehensive demographic or behavioral data on individual listeners. This limits the ability to assess deeper patterns such as age, educational background, or learning preferences. Second, engagement was measured primarily through listening counts and durations, which may not fully capture the quality or educational impact of the content. Additionally, while the study focused on chemistry-related podcasts, the findings may not be generalizable to other academic disciplines or non-English-speaking audiences. Finally, the use of AI in TNCP was varied across episodes, and the study

did not isolate the specific AI features contributing most to engagement, making it difficult to pinpoint which tools had the strongest influence.

CONCLUSION

This comparative study of TNCP and LCP demonstrates the transformative power of AI in education, particularly in improving listener engagement, content personalization, and global accessibility. While traditional lecture formats like LCP still hold value in certain regions, the evidence strongly supports the effectiveness of AI-powered methods in enhancing educational experiences and reaching broader audiences. As educational technology continues to advance, incorporating AI thoughtfully can bridge learning gaps, foster equity, and redefine how knowledge is delivered in the digital age.

Conflict of Interest Statement

The author declares no conflict of interest related to the research, authorship, or publication of this manuscript. No financial, personal, or professional affiliations influenced the content, analysis, or conclusions presented. The study was conducted independently and did not receive funding or support from any herbal product manufacturers or commercial entities.

REFERENCES

1. Baker, R. S., & Inventado, P. S. (2014). Educational data mining and learning analytics. Springer.
2. Balfour, S. P. Assessing writing in MOOCs: Automated essay scoring and calibrated peer review. Research & Practice in Assessment, 2013; 8: 40–48.
3. Baskara, K., & Seo, J.-Y. AI-assisted narrative writing for EFL College students. Language Teaching Research Quarterly, 2024; 43: 1–21. https://doi.org/10.32038/ltrq.2024.43.01
4. Cambria, E., & White, B. Jumping NLP curves: A review of natural language processing research. IEEE Computational Intelligence Magazine, 2014; 9(2): 48–57. https://doi.org/10.1109/MCI.2014.2307227
5. Chen, X., Zou, D., Xie, H., & Liu, M. NLP in education: A review. Educational Research Review, 2020; 30: 100110.
6. Do, T. D., et al. (2024). PAIGE system. arXiv preprint.
7. Goel, A., & Polepeddi, L. (2016). Jill Watson: A virtual teaching assistant for online education. Georgia Institute of Technology.

8. Graesser, A. C., Chipman, P., Haynes, B. C., & Olney, A. AutoTutor: An intelligent tutoring system with mixed-initiative dialogue. IEEE Transactions on Education, 2005; 48(4): 612–618.
9. Holmes, W., Bialik, M., & Fadel, C. (2019). AI in education: Implications for teaching. CCR.
10. Holmes, W., Bialik, M., & Fadel, C. (2019). Artificial Intelligence in Education: Promises and Implications for Teaching and Learning. Boston: Center for Curriculum Redesign.
11. Jafarian, N. R., & Kramer, A.-W. (2025). Computers & Education: Artificial Intelligence, 8, Article 100357. https://doi.org/10.1016/j.caeai.2024.100357
12. Jordan, M. I., & Mitchell, T. M. Machine learning: Trends, perspectives, and prospects. Science, 2015; 349(6245): 255–260. https://doi.org/10.1126/science.aaa8415
13. Luckin, R., Holmes, W., Griffiths, M., & Forcier, L. (2016). Intelligence unleashed: AI in education. Pearson.
14. Mayer, R. E. (2009). Multimedia learning. Cambridge University Press.
15. Nye, B. D. Intelligent tutoring systems by the numbers: A meta-analysis. Journal of Educational Data Mining, 2015; 7(2): 1–24.
16. OECD. (2020). AI in education: Opportunities for learning and policy. OECD.
17. Siemens, G. Connectivism: A learning theory for the digital age. International Journal of Instructional Technology and Distance Learning, 2014; 3(1): 1–8.
18. Siemens, G., & Long, P. Penetrating the fog: Analytics in learning and education. EDUCAUSE Review, 2011; 46(5): 30–40.
19. Ullman, D., Winne, P. H., & Nesbit, J. C. Self-regulated learning and learning analytics: A review of empirical research. British Journal of Educational Technology, 2020; 51(2): 513–536. https://doi.org/10.1111/bjet.12897
20. UNESCO. (2021). AI in education: Challenges and opportunities. UNESCO.
21. VanLehn, K. Effectiveness of tutoring systems. Educational Psychologist, 2011; 46(4): 197–221.
22. VanLehn, K. The relative effectiveness of human tutoring, intelligent tutoring systems, and other tutoring systems. Educational Psychologist, 2011; 46(4): 197–221. https://doi.org/10.1080/00461520.2011.611369
23. VanLehn, K. Tutoring effectiveness comparison. Educational Psychologist, 2011; 46(4): 197–221.

24. Winkler, R., & Söllner, M. (2018). Unleashing the potential of chatbots in education: A state-of-the-art analysis. Proceedings of the International Conference on Information Systems (ICIS).
25. Woolf, B. P. (2009). Building intelligent interactive tutors. Morgan Kaufmann.
26. Zawacki-Richter, O., Marín, V. I., Bond, M., & Gouverneur, F. Systematic review of research on artificial intelligence applications in higher education – where are the educators? International Journal of Educational Technology in Higher Education, 2019; 16(1): 1–27. https://doi.org/10.1186/s41239-019-0171-0