Jurnal Ilmu Siber dan Teknologi Digital (JISTED)
ISSN: 2986-7312, Vol 4, No 2, 2026, 1-19 https://doi.org/10.35912/jisted.v4i2.6676

Star Trek's Technological Predictions and Their Impact on Modern Innovation

Derah Sudjaniah[1*], Bintoro Ariyanto[2]
Sekolah Tinggi Ilmu Ekonomi Bhakti Pembangunan, Jakarta, Indonesia[1,2]
sudjaniah@gmail.com[1*]

Article History
Received on 07 February 2026
1st Revised on 17 February 2026
2nd Revised on 20 March 2026
3rd Revised on 15 April 2026
Accepted on 27 April 2026

Abstract
Purpose: This study examines the relationship between futuristic technologies portrayed in the Star Trek series and the development of modern technological innovation, highlighting how science fiction can influence technological advancement.
Research Methodology: A descriptive qualitative approach with a literature review method was employed. Data were collected from academic journals, books, technology reports, digital documentation, and technological representations presented in Star Trek. The data were analyzed using content, comparative, and interpretative analysis.
Results: The findings reveal significant similarities between Star Trek technologies and contemporary innovations, including smartphones, digital tablets, artificial intelligence, smart assistants, AI-based translation systems, wearable devices, virtual reality, digital healthcare technologies, video communication, and smart automation.
Conclusions: The study demonstrates that Star Trek serves not only as entertainment but also as a form of technological foresight that can inspire scientific research, innovation, and digital transformation.
Limitations: This research is limited to secondary data and literature-based analysis without empirical evidence from technology developers, users, or audiences.
Contributions: This study contributes to the fields of media studies, communication studies, digital transformation, and technology innovation by providing insights into the relationship between science fiction narratives and real technological advancement.

Keywords: *Artificial Intelligence, Digital Transformation, Science Fiction, Star Trek, Technological Innovation*

How to Cite: Sudjaniah, D., Ariyanto, B. (2026). Star Trek's Technological Predictions and Their Impact on Modern Innovation. *Jurnal Ilmu Siber dan Teknologi Digital,* 4(2), 1-19.

1. Introduction

Since its first release in 1966 through the series Star Trek created by Gene Roddenberry, Star Trek has been widely recognized as one of the most visionary science fiction works in the history of popular media development (Space, 2021). At that time, many of the technologies presented in Star Trek were considered futuristic imaginations that were difficult to realize in real life. However, by 2025, many technological concepts that once existed only as science fiction have evolved into real components of modern society (Mcardle, 2016). The communicator device in Star Trek resembles modern smartphones, the voice computer system has developed into smart assistants such as Siri and Alexa, the universal translator resembles AI-based machine learning translation systems, while the PADD (Personal Access Display Device) shares similarities with contemporary digital tablets (Space, 2021). This phenomenon demonstrates that science fiction functions not only as entertainment, but also as an important source of inspiration for the development of modern technological innovation (Space, 2021). The development of digital technology over the past few decades has experienced rapid transformation, particularly in the fields of Artificial Intelligence (AI), smartphones, wearable devices, video

communication, machine learning, and smart assistants. AI technology has become an essential part of modern life because it enhances automation, service personalization, and the efficiency of human interaction with digital devices (Idkhajine, Aarab, & Monmasson, 2023; Seng, Ang, Peter, & Mmonyi, 2023). Advances in smartphones and edge computing have also accelerated the emergence of intelligent devices increasingly integrated with AI and machine learning technologies (Nicholas, Ozioko, & Nwigwe, 2022). These developments can be observed in wearable devices such as smartwatches, smart health monitoring systems, and intelligent assistants capable of delivering real-time data-based services (Seng et al., 2023).

Furthermore, the growth of voice-based smart assistants such as Siri, Alexa, and Google Assistant demonstrates how human computer interaction is increasingly shifting toward natural communication through voice recognition and natural language processing technologies (S.-H. Kim et al., 2020). These innovations enable digital devices to understand user commands in a more interactive and adaptive manner (Balakrishnan & Dwivedi, 2024). Interestingly, the phenomenon of modern technological advancement had long been portrayed in various science fiction works. Science fiction films and television series function not only as entertainment media, but also as platforms representing human imagination regarding the future of technology, communication, and digital life (Bhowmick, Kundu, & Mandal, 2021). One of the science fiction series most frequently associated with predictions of future technology is Star Trek.

The Star Trek series is widely recognized for introducing futuristic technological concepts that were once considered impossible, yet many of them have now become part of everyday reality (Flower & Ahlefeldt, 2021). These technologies include the communicator, which resembles modern smartphones; the universal translator, which is comparable to AI-based translation systems; the voice computer, which shares similarities with smart assistants such as Siri and Alexa; and the Personal Access Display Device (PADD), which resembles modern tablet devices (Ortiz, Graziano, & Ewig, 2020; Pogue, 2018). The phenomenon of "from science fiction to science fact" illustrates that science fiction not only creates visual entertainment but also significantly influences the direction of modern technological innovation. Many scientists, engineers, and technology developers have been inspired by futuristic concepts presented in science fiction series to create real-world innovations in contemporary society (Skulinová, Novák, Kolářová, & Kašný, 2022). Nevertheless, most previous studies have primarily discussed science fiction from the perspectives of popular culture, fandom, media narratives, and visual communication (Ye, Luo, Yang, Choo, & He, 2023). Studies specifically examining the relationship between representations of futuristic technology in science fiction and the development of modern digital innovation, particularly within the context of artificial intelligence and contemporary technological transformation, remain relatively limited (Nelke et al., 2023). Therefore, research exploring the connection between science fiction and real technological innovation still offers broad opportunities for further development in modern academic studies (Taneja et al., 2023).

Previous studies on science fiction and modern technology have primarily focused on the technical and social development of artificial intelligence, virtual reality, smart devices, and digital communication (Nelke et al., 2023; Ye et al., 2023). However, most existing studies examine these technological developments separately and provide limited discussion regarding how futuristic technological representations in science fiction media such as Star Trek relate to real-world technological innovation. In addition, prior research generally positions science fiction as entertainment and popular culture rather than as a form of technological foresight capable of shaping technological imagination and influencing future innovation trajectories (Taneja et al., 2023). Furthermore, studies specifically examining the phenomenon of "from science fiction to science fact" through the integration of content analysis, comparative analysis, and interpretative analysis remain relatively limited. Most previous research focuses on a single technological domain, such as artificial intelligence, virtual reality, or digital communication. In contrast, the technological ecosystem portrayed in Star Trek encompasses a broader range of innovations, including communicators, PADD devices, voice computers, universal translators, tricorders, wearable technologies, holographic systems, and intelligent automation. This gap highlights the need for a more comprehensive analysis that investigates the interconnected relationship between science fiction representations and technological development.

Therefore, the novelty of this study lies in its comprehensive analysis of futuristic technological representations in Star Trek through the perspective of "from science fiction to science fact." This study integrates various technological innovations, including smartphones, artificial intelligence, AI translation systems, wearable technology, digital healthcare, virtual reality, and smart automation, within a single analytical framework. In addition, this research positions Star Trek not only as entertainment media but also as a form of technological foresight that contributes to shaping technological imagination and influencing the direction of modern technological innovation. Based on this perspective, this study aims to analyze the relationship between the representation of futuristic technology in Star Trek and the development of modern technology through a qualitative literature review approach. This research is expected to provide a deeper understanding of how science fiction contributes to the advancement of digital innovation and shapes public imagination regarding future technology in modern society.

2. Literature Review

2.1 Science Fiction and Technological Imagination

Science fiction is widely recognized not only as a form of entertainment but also as a medium through which societies imagine and evaluate possible technological futures. By presenting speculative yet scientifically grounded innovations, science fiction creates narratives that connect technological development, human behavior, and social transformation (James & Mendlesohn, 2003). The theory of science fiction suggests that representations of futuristic technologies can shape public perceptions of what is technologically possible and desirable in the future (Chow-White, Deveau, & Adams, 2015). In addition, science fiction functions as a form of cultural imagination that introduces technological concepts before they emerge in everyday life (Pinto-Ferreira et al., 2019). This perspective is highly relevant to the present study because Star Trek portrays a range of futuristic technologies that later became comparable to modern innovations. Therefore, science fiction provides a useful theoretical lens for understanding how technological imagination represented in media may contribute to real-world technological development.

2.2 Technological Determinism and Digital Transformation

Technological Determinism explains how technological advancement influences social structures, communication patterns, cultural practices, and human behavior by positioning technology as a key driver of societal change (Taylor, 2018). The widespread adoption of the internet, smartphones, artificial intelligence, and digital media demonstrates the transformative impact of technology on contemporary society (William, 2026). Within the context of this study, Technological Determinism helps explain why technologies represented in science fiction may become socially significant once they are translated into practical innovations. Furthermore, media representations of futuristic technologies can contribute to shaping expectations regarding technological progress and digital transformation (Stokes, 2026). Accordingly, Star Trek can be understood not only as a reflection of technological possibilities but also as a cultural influence that contributes to the broader discourse surrounding innovation and digital change.

2.3 Diffusion of Innovation and Foresight Technology

Diffusion of Innovation theory explains how new technologies and ideas are introduced, communicated, and gradually adopted within society (Jena, Vashisht, Basu, Ungar, & Sedoc, 2017). The adoption process is influenced by factors such as perceived usefulness, compatibility, complexity, and social acceptance. In relation to this study, the theory provides a framework for understanding how technological concepts initially presented as fictional ideas may eventually become accepted and integrated into everyday life. Technologies such as smartphones, AI assistants, wearable devices, and video communication systems illustrate how innovations resembling those portrayed in Star Trek have diffused into society over time. The concept of foresight technology complements this perspective by emphasizing the exploration of possible futures based on technological, social, economic, and cultural trends (Varma et al., 2021). Rather than predicting a single future outcome, foresight approaches examine alternative scenarios that may guide innovation and decision-making (Bui, 2021; Su, Yuan, Umar, & Lobont, 2022). This perspective has been widely applied to studies of artificial intelligence,

smart cities, digital transformation, and communication technologies (Alhindi, Alsaidi, & Munshi, 2022). In the context of this research, foresight technology provides an important explanation for how science fiction can function as a medium through which future technological possibilities are imagined and communicated (Carnevale, Tangari, Iannone, & Sartini, 2023). As argued by previous studies, science fiction may serve as a laboratory of imagination that inspires technological innovation and future-oriented thinking (Anthis & Paez, 2021). Therefore, Star Trek represents a relevant case for examining how fictional technological visions contribute to shaping technological imagination and innovation in contemporary society.

3. Methodology

This study employs a descriptive qualitative approach using a qualitative literature review method. The qualitative approach was selected to understand and analyze the relationship between representations of futuristic technologies in science fiction media and the development of modern technology in a comprehensive and interpretative manner (Poth & Shannon-Baker, 2022). The qualitative literature review method enables researchers to identify, evaluate, and interpret various studies and documents related to digital technology development and futuristic representations in science fiction media (Mutanana & Shoko, 2026). This approach is widely applied in media, social, and technology studies to systematically examine relationships among concepts and technological phenomena.

The data sources used in this study were obtained from various academic and non-academic references relevant to the research topic (Bayuo, Nyande, Awunyo, & Akpalu, 2025). The data consisted of scientific journals, academic books, technology articles, documentation of digital innovation development, and episodes and films from Star Trek that portray futuristic technological representations (Bayuo et al., 2025). Scientific journals were used to establish the theoretical foundation concerning science fiction, technological determinism, diffusion of innovation, and future studies, while academic books strengthened the conceptual understanding of the relationship between media, technology, and social transformation. In addition, technology articles and digital innovation documentation were used to compare modern technological developments with the futuristic technologies represented in Star Trek (Soundy, 2026). To ensure the relevance and quality of the reviewed sources, inclusion and exclusion criteria were established. The inclusion criteria consisted of: (1) academic publications discussing science fiction, technological innovation, digital transformation, artificial intelligence, or future studies; (2) sources directly related to Star Trek and its technological representations; (3) publications providing information regarding contemporary technological developments; and (4) English-language sources with accessible full texts. The exclusion criteria consisted of: (1) publications unrelated to technology or science fiction; (2) duplicate documents; (3) sources lacking sufficient methodological or conceptual information; and (4) publications that did not contribute directly to the objectives of this study.

Data collection was conducted through documentation studies and literature exploration using academic databases, technology articles, and digital media documentation that were directly accessible to researchers. According to Creswell and Creswell (2018), documentation studies in qualitative research enable researchers to obtain data from written documents, archives, visual media, and digital sources relevant to the research phenomenon. The data analysis techniques employed in this study consisted of content analysis, comparative analysis, and interpretative analysis (Crescentini & Punziano, 2026). These analytical techniques were implemented through a systematic four-step procedure to provide an in-depth understanding of the phenomenon of “from science fiction to science fact” within the context of modern digital transformation.

The first step involved data identification and selection. At this stage, relevant literature, technology reports, digital innovation documentation, and Star Trek episodes and films were identified and screened according to the inclusion and exclusion criteria. The second step involved content analysis to identify representations of futuristic technologies presented in Star Trek. This analysis examined dialogues, technological visualizations, device functions, and interactions between humans and technology appearing throughout the series (Poth & Shannon-Baker, 2022). Through this process, technologies such as communicators, universal translators, voice computers, tricorders, and PADD

devices were categorized according to their functions and technological characteristics (Jaylo et al., 2026).

The third step involved comparative analysis, which compared the technologies portrayed in Star Trek with contemporary technological developments. The analysis focused on similarities and differences in functions, forms, and applications between fictional technologies and modern innovations such as smartphones, AI assistants, video communication platforms, tablets, wearable devices, and AI-based translation systems (Wutich, Beresford, & Bernard, 2024). This stage helped explain how technological concepts initially presented as science fiction evolved into practical innovations through scientific advancement and digital transformation. The fourth step involved interpretative analysis to examine the broader meaning and implications of the relationship between science fiction and technological innovation. This stage explored how science fiction contributes to shaping public imagination regarding future technologies and influences societal perceptions of technological development (Poth & Shannon-Baker, 2022). Based on the findings from the previous stages, the study interpreted the role of Star Trek as a form of technological foresight that not only reflects technological possibilities but also contributes to discussions concerning innovation and future technological development (Wutich et al., 2024).

4. Results and Discussions

The findings reveal that several technologies portrayed in *Star Trek* share notable similarities with contemporary technological innovations. Through content, comparative, and interpretative analyses, the study identified ten major technological domains that illustrate the phenomenon of "from science fiction to science fact." These technologies and their modern equivalents are summarized in Table 1.

Table 1. Comparison of star trek technologies and modern technological innovations

No.	Star Trek Technology	Modern Equivalent Technology	Main Function	Similarity Level
1	Communicator	Smartphone	Wireless communication	High
2	PADD (Personal Access Display Device)	Digital Tablet (iPad, Galaxy Tab)	Digital information access and communication	High
3	Voice Computer	Smart Assistants (Siri, Alexa, Google Assistant)	Voice interaction and information retrieval	High
4	Universal Translator	AI Translation Systems	Real-time language translation	High
5	Visual Communication System	Zoom, Google Meet, FaceTime	Video communication	High
6	Tricorder	Digital Health Devices and Wearables	Health monitoring and diagnostics	Moderate–High
7	Automatic Door	Motion Sensor and Smart Automation Systems	Automated access control	High
8	Wearable Devices	Smartwatch and Wearable Technology	Monitoring and communication	High
9	Hologram and Holodeck	Virtual Reality (VR) and Augmented Reality (AR)	Immersive simulation	Moderate
10	Interactive Computer	Artificial Intelligence and Generative AI	Intelligent interaction and decision support	High

Table 1 shows that many technologies originally presented as futuristic concepts in *Star Trek* have evolved into practical innovations in modern society. The strongest similarities can be observed in communication technologies, artificial intelligence systems, digital assistants, wearable devices, and smart automation. Although some technologies, such as holographic environments and advanced diagnostic devices, have not yet reached the level depicted in the series, current technological developments demonstrate substantial progress toward their realization. These findings support the

argument that science fiction can function as a source of technological imagination that influences innovation and digital transformation.

4.1 Fictional Technologies in Star Trek That Became Reality

Star Trek is widely recognized for introducing futuristic technologies that were once considered purely fictional but have gradually become part of modern technological reality. Several innovations presented in the series, such as communicators, voice-controlled computers, universal translators, and digital tablets, closely resemble technologies used in contemporary society today. This phenomenon illustrates how science fiction can inspire the development of real-world technological innovations in the modern digital era.

4.1.1 Communicators and Modern Smartphones

Figure 1. Communicators and modern smartphones

Figure 2 show communicator featured in Star Trek: The Original Series represents one of the futuristic technologies most comparable to modern smartphones. In several episodes, crew members of the USS Enterprise used the communicator as a compact and portable device that enabled instant wireless voice communication across different locations. Its lightweight design supported mobility and reflected the concept of personal communication technology long before mobile phones became widely adopted in society. The communicator not only facilitated long-distance communication but also introduced the idea of a practical and flexible device that could be carried and used anywhere. This concept closely resembles contemporary smartphones, which have evolved into multifunctional devices supporting voice and video communication, social media access, digital navigation, electronic transactions, and AI-based assistants. Advances in wireless networks, internet connectivity, and mobile computing have enabled many of the communication concepts portrayed in Star Trek to become part of everyday life. These similarities demonstrate how Star Trek anticipated the evolution of portable digital communication technologies decades before their widespread implementation. The communicator serves as an example of how science fiction can stimulate technological imagination and contribute to public expectations regarding the future development of communication technology.

4.1.2 PADD and Digital Tablets

Figure 2. PADD and digital tablets

Figure 2 show PADD featured in *Star Trek: The Next Generation* bears a strong resemblance to modern digital tablets such as the Apple iPad and Samsung Galaxy Tab. In the series, the PADD was used to read digital documents, store information, access data, and facilitate portable communication (Zheng & Li, 2020). Its touchscreen interface enabled users to interact directly with digital content through the display screen. At the time the series was broadcast, portable touchscreen devices remained largely conceptual, as computing technologies were predominantly desktop-based and relied on physical keyboards (Grinschgl, Meyerhoff, & Papenmeier, 2020; Iqbal & Bhatti, 2020).

Many of the functions portrayed through the PADD are now integrated into contemporary tablet devices used in education, healthcare, business, administration, and digital communication. Advances in portable computing technologies have transformed tablets into multifunctional devices that support information access, communication, and productivity in various daily activities (Yeung & Ng, 2023). The similarities between the PADD and modern tablets illustrate how *Star Trek: The Next Generation* anticipated the emergence of a mobile digital ecosystem before such technologies became widely available. This representation highlights the role of science fiction in shaping public imagination regarding the integration of portable digital devices into everyday life (Amir, Huda, & Maksum, 2020; Nurjaya, Maulana, Maulida, & Laratmase, 2024; Yang, 2025).

4.1.3 Voice Computer and Smart Assistant

Figure 3. Voice computer and smart assistant

Figure 3 show voice computer system featured in *Star Trek* shares notable similarities with modern smart assistants such as Apple Siri, Amazon Alexa, and Google Assistant. In the series, crew members of the USS *Enterprise* interacted with the ship's computer through voice commands to retrieve information, operate onboard systems, perform data searches, and support decision-making processes (Oyibo & Vassileva, 2021). The system demonstrated capabilities comparable to voice recognition and artificial intelligence technologies, allowing users to communicate naturally with computers through spoken language (Sodhro, Awad, van de Beek, & Nikolakopoulos, 2022).

Many of these functions are now incorporated into contemporary smart assistants powered by natural language processing and machine learning technologies. Modern AI assistants can understand user requests, provide information, control connected devices, and support various digital activities across smartphones, smart homes, intelligent vehicles, and other technology ecosystems (Rainarli, 2021). The similarities between the voice computer system in *Star Trek* and current AI-powered assistants illustrate how the series anticipated the development of human–computer interaction long before artificial intelligence became a central component of digital transformation (Kennedy, Sood, Chakraborty, & Chitta, 2022). This representation further highlights the role of science fiction as a medium for exploring future intelligent computing systems and their potential integration into everyday life (Jin, Mu, Tian, & Ran, 2020; Q. Li, Liu, Wang, & Li, 2023).

4.1.4 Universal Translator and AI Translation

Figure 4. Universal translator and ai translation

Figure 4 show universal translator featured in *Star Trek* bears strong similarities to modern AI-based translation technologies such as Google Translate and real-time translation devices. In the series, the universal translator enabled automatic communication between different species by translating multiple languages instantly and accurately (Tan et al., 2020). The device illustrated the concept of automated language processing and real-time translation long before such technologies became widely available. Its functionality reflected the ability of intelligent systems to recognize, interpret, and translate foreign languages during communication (Gaspar, Correia, & Torres, 2021). Recent advances in artificial intelligence, speech recognition, neural machine translation, and machine learning have enabled the development of translation technologies capable of automatically converting spoken and written language into different languages in real time. These technologies are now widely integrated into smartphones, wearable translation devices, and global communication systems, facilitating communication across linguistic boundaries (Tigga & Garg, 2020).

The similarities between the universal translator and contemporary translation technologies demonstrate how *Star Trek* anticipated the evolution of AI-driven language solutions within an increasingly interconnected world (Fernández Fortunato, Jiménez-Sáez, & Hontoria, 2023; Ko, 2022). This representation further highlights the role of science fiction in shaping public imagination regarding seamless cross-language communication and the removal of technological barriers in global interaction (S. Li et al., 2022; Wen, Liu, Ouyang, Lin, & Chung, 2021).

4.1.5 Video Call and Virtual Communication

Figure 5. Video call and virtual communication

The visual communication system portrayed in *Star Trek* shares strong similarities with modern video communication platforms such as Zoom, Google Meet, and FaceTime. In the series, communication between spacecraft and crew members was conducted through visual screens that enabled real-time audio and video interaction (Paredes-Frigolett, Pyka, & Leoneti, 2021). At the time the series was produced, such communication capabilities were largely considered futuristic because internet infrastructure and digital communication networks were still in their early stages of development. Nevertheless, *Star Trek* presented a vision of long-distance communication supported by interactive visual technologies (Lindsay, 2022).

Today, video communication has become an essential component of education, business operations, remote work, healthcare services, and social interaction worldwide. Advances in internet connectivity, digital platforms, and communication technologies have transformed video conferencing into a routine aspect of daily life. The COVID-19 pandemic further accelerated the adoption of video communication technologies across various sectors (Mugambi, Blanco, Ogachi, Ferasso, & Bares, 2021). The similarities between the communication systems depicted in *Star Trek* and contemporary video conferencing technologies demonstrate how the series anticipated the growing importance of virtual communication long before global internet access became widespread (Feng, Chen, & Niu, 2022). This representation highlights the capacity of science fiction to envision changes in human communication patterns and their integration into the modern digital environment.

4.1.6 Tricorder and Digital Health Technology

Figure 6. Tricorder and digital health technology

Figure 6 tricorder portrayed in *Star Trek* shares strong similarities with modern portable medical devices and wearable health technologies. In the series, the tricorder was used to assess health conditions, analyze environmental factors, and perform rapid medical diagnostics without invasive procedures (Bent, Goldstein, Kibbe, & Dunn, 2020). The device reflected the concept of portable healthcare technology by enabling users to obtain medical information quickly and efficiently through a compact and mobile system (Krausz, Korley, & Burns, 2021). Recent advances in digital healthcare have led to the development of portable medical scanners, smart health watches, wearable monitoring devices, and AI-assisted diagnostic systems. These technologies enable individuals to monitor heart rate, oxygen saturation, sleep quality, physical activity, and other health indicators in real time through digital platforms (Hamza & Saegh, 2023; Le et al., 2021). The similarities between the tricorder and contemporary healthcare technologies illustrate how *Star Trek* anticipated the growing integration of digital diagnostics, wearable monitoring, and artificial intelligence into medical practice (Bressan et al., 2021). This representation highlights the role of science fiction in envisioning future healthcare systems and encouraging technological imagination related to medical innovation and digital health transformation (C.-H. Kim et al., 2022; Liu et al., 2022).

4.1.7 Automatic Door and Sensor Technology

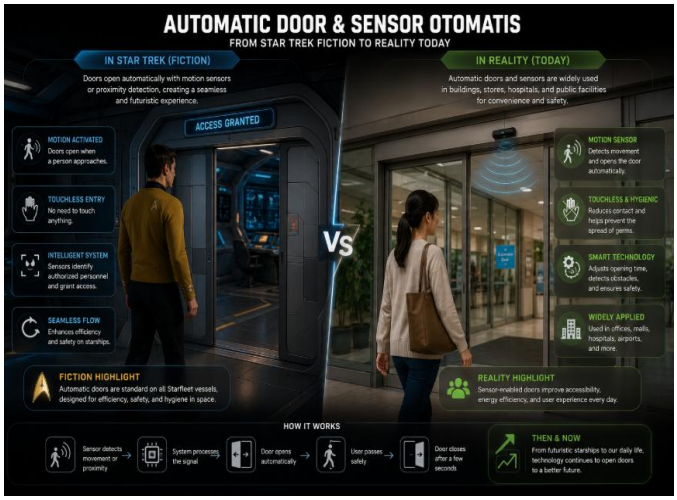

Figure 7. Automatic door and sensor technology

Figure 7 automatic doors featured in *Star Trek* share significant similarities with modern sensor-based automation technologies that are now widely implemented in shopping centers, hospitals, hotels, airports, and smart buildings. In the series, doors opened automatically whenever a person approached, eliminating the need for physical contact (Saitov, Polevaya, & Filchenkov, 2020; Shi, Haga, & Okada, 2021). This functionality reflected the concept of intelligent automation, in which systems respond automatically to human presence through sensor-based detection mechanisms (Huang, Hao, Wang, & Jones, 2022; Omidi, Jahangiri, Mohammadidehcheshmeh, & Mostafaeipour, 2021). Advances in motion sensors, artificial intelligence, and smart infrastructure technologies have enabled the widespread adoption of automated access systems across various public and commercial facilities. These technologies are designed to improve operational efficiency, user convenience, accessibility, and safety while reducing the need for manual interaction (Aryan, Bosché, & Tang, 2021). similarities between the automatic doors depicted in *Star Trek* and contemporary automation systems demonstrate how the series anticipated the integration of smart technologies into everyday environments long before such systems became commonplace. This representation highlights the role of science fiction in shaping technological imagination regarding automation and intelligent infrastructure in modern society (Bezuidenhout, Thurston, Hagströmer, & Moulaee Conradsson, 2021; Zanelli et al., 2022).

4.1.8 Wearable Technology and Smartwatch

Figure 8. Wearable technology and smartwatch

Figure 8 show wearable devices portrayed in *Star Trek* bear strong similarities to modern smartwatches and other wearable technologies. In the series, these devices were used to monitor activities, facilitate communication, and support digital identification of personnel (Rodrigues, Souza, Coelhoso, &

Fernando, 2021; Wang, Li, Li, Wang, & Xu, 2021). Their functions reflected the concept of an interconnected wearable digital ecosystem in which portable devices provide continuous access to information and communication services (Lahlou, Kara, & Edstrom, 2022; Okayama et al., 2022). Advances in sensor technologies, internet connectivity, artificial intelligence, and mobile computing have enabled modern wearable devices to perform a wide range of functions, including health monitoring, GPS tracking, digital communication, and AI-assisted services. Contemporary smartwatches have become multifunctional tools that support both personal and professional activities through real-time data collection and analysis (Alshammeri, Atwell, & ammar Alsalka, 2021; Felius et al., 2022). The similarities between wearable technologies depicted in *Star Trek* and current smart devices demonstrate how the series anticipated the growing integration of digital technologies into everyday life. This representation highlights the influence of science fiction in shaping public imagination regarding the future development of wearable computing and connected digital ecosystems (Gupta, Khan, Nazir, Shafiq, & Shabaz, 2023).

4.1.9 Virtual Reality and Hologram

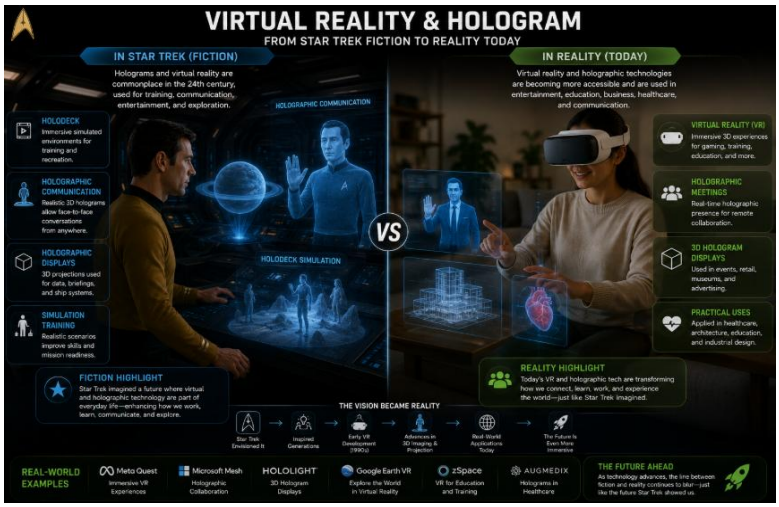

Figure 9. Virtual reality and hologram

Figure 9 show hologram and virtual simulation technologies portrayed in *Star Trek* share strong similarities with modern Virtual Reality (VR) and Augmented Reality (AR) technologies. In the series, holographic environments were used for training, simulation, entertainment, and immersive digital interaction, allowing users to engage with realistic virtual settings (Lee, Shi, & Doh, 2021). These technologies illustrated the concept of immersive digital experiences in which individuals could interact with virtual objects and environments in ways that closely resembled real-world situations (Galnares, Nesmachnow, & Simini, 2021). Recent developments in VR and AR technologies have expanded their applications across education, gaming, healthcare, military training, and digital business environments. Although current systems still depend on headsets, sensors, and specialized digital devices, their fundamental principles closely resemble the virtual simulation concepts depicted in *Star Trek* (Martin, 2025). The similarities between these technologies demonstrate how the series anticipated the growing importance of immersive digital environments long before VR and AR became widely adopted. This representation highlights the role of science fiction in exploring future forms of human interaction within virtual worlds and inspiring innovation in immersive technologies (Murphy & Creux, 2021).

4.1.10 Artificial Intelligence and Interactive Computers

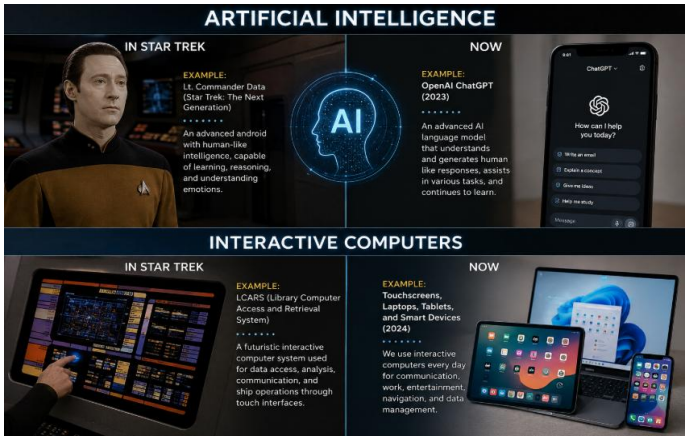

Figure 10. Artificial intelligence and interactive computers

Figure 10 show interactive computer systems portrayed in *Star Trek* share significant similarities with modern artificial intelligence technologies, including ChatGPT, generative AI, and intelligent computing systems. In the series, the ship's computer was capable of understanding human language, providing automated responses, managing large amounts of information, and supporting decision-making processes through natural verbal interaction(Acharjee & Panicker, 2023). These capabilities reflected the concept of intelligent computing systems that could interact with users in a conversational and context-aware manner, long before such technologies became widely available (Irfan et al., 2021). Recent advances in generative artificial intelligence, large language models, and natural language processing have enabled modern computer systems to communicate with humans more effectively through automated and adaptive interactions. These technologies are now applied across various sectors, including education, healthcare, business, customer service, and scientific research, where AI systems assist users in information retrieval, problem-solving, and decision support (Bao, Zhang, & Gao, 2022). The similarities between the interactive computer systems depicted in *Star Trek* and contemporary AI technologies demonstrate how the series anticipated the growing role of intelligent machines in everyday life. This representation highlights the capacity of science fiction to function as a laboratory of imagination that inspires technological innovation and shapes societal expectations regarding the future of artificial intelligence(Rismani et al., 2023).

4.2 Discussion

The findings of this study demonstrate that futuristic technologies portrayed in Star Trek have a strong relationship with the development of modern digital technologies. Through content, comparative, and interpretative analysis, the study reveals that many fictional technologies such as communicators, PADDs, voice-controlled computers, universal translators, tricorders, wearable devices, holograms, and AI systems have evolved into real-world innovations including smartphones, tablets, smart assistants, machine translation systems, wearable health technologies, VR/AR, and generative AI. These findings indicate that Star Trek functions not only as entertainment but also as a form of cultural and technological foresight that shapes public imagination and supports the theory of technological determinism by showing how technology influences social change and human interaction.

In addition, the study highlights how specific technological representations in Star Trek closely resemble modern digital developments. The communicator parallels smartphones with mobile connectivity and wireless communication, while the PADD reflects modern tablets used in education, business, and administration. The voice-controlled computer resembles contemporary AI assistants such as Siri, Alexa, and Google Assistant, enabled by advances in natural language processing and machine learning. Similarly, the universal translator aligns with modern AI translation systems, and visual communication systems resemble video conferencing technologies like Zoom and Google Meet. In healthcare, the tricorder parallels wearable health devices and AI diagnostic tools, while automation systems such as automatic doors reflect modern sensor-based technologies. Wearable devices and

holographic simulations further correspond to smartwatches, AR/VR systems, and immersive digital environments widely used today.

Overall, the study concludes that Star Trek serves as a powerful form of technological foresight that helps shape future-oriented thinking in society. Science fiction is not only a medium of entertainment but also a "laboratory of imagination" that influences innovation, supports diffusion of innovation theory, and inspires developments in digital communication, artificial intelligence, healthcare, and immersive technologies. The relationship between science fiction media and technological progress is therefore dynamic and mutually reinforcing, where fictional ideas both reflect and inspire real-world technological advancements. This supports the concept of "from science fiction to science fact," demonstrating that futuristic imagination plays a crucial role in accelerating modern technological transformation.

5. Conclusions

5.1 Conclusion

This study explores the relationship between futuristic technologies depicted in the Star Trek series and the development of modern digital technologies using a qualitative literature review with content, comparative, and interpretative analysis. The findings show that many fictional technologies such as communicators, AI systems, voice-controlled computers, universal translators, tricorders, wearables, and holograms closely resemble contemporary innovations like smartphones, artificial intelligence, telemedicine, virtual reality, and smart devices, indicating that science fiction has evolved into real technological applications. The study highlights Star Trek as a form of technological foresight that shapes innovation, supports theoretical perspectives on technological determinism and diffusion of innovation, and emphasizes that science fiction can inspire technological development, enhance digital literacy, and inform future-oriented innovation policies.

5.2 Research Limitations

This study has several limitations. First, the research focuses exclusively on Star Trek and does not compare technological representations with other science fiction franchises such as Blade Runner, The Matrix, or Star Wars. Second, the study employs a qualitative literature review approach without involving interviews, surveys, or direct observations with technology developers, digital technology users, or science fiction audiences. Third, the research mainly discusses the relationship between science fiction and technological development without examining in depth the ethical, psychological, and social impacts of artificial intelligence and digital transformation in modern society.

5.3 Suggestions and Directions for Future Research

Future research is recommended to compare futuristic technological representations across various science fiction franchises such as Blade Runner, The Matrix, and Star Wars in order to provide a broader understanding of the relationship between science fiction media and modern technological innovation. Subsequent studies may also employ mixed-method approaches by combining qualitative literature reviews with interviews, surveys, or empirical observations involving technology developers, AI users, and science fiction audiences to obtain deeper insights into the influence of futuristic media on public perceptions of technology. In addition, future research is encouraged to explore the ethical and social implications of technologies previously predicted in science fiction, particularly issues related to artificial intelligence, digital privacy, technological dependency, cybersecurity, and data protection in the era of digital transformation.

Acknowledgement

The author would like to express sincere gratitude to all scholars, researchers, and institutions whose publications and academic contributions supported the completion of this study. Appreciation is also extended to the creators and production team of Star Trek for inspiring discussions regarding the relationship between science fiction and technological innovation.

Author Contributions

DS contributed to the conceptualization of the study, literature review, data analysis, interpretation of findings, and manuscript drafting. BA contributed to methodological design, validation of the analysis, critical revision of the manuscript, and supervision of the research process. Both authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

References

Acharjee, S., & Panicker, A. T. (2023). Trust levels in social networks. *Heliyon, 9*(9). doi:https://doi.org/10.1016/j.heliyon.2023.e19850

Alhindi, A., Alsaidi, A., & Munshi, A. (2022). Vehicle Routing Optimization for Non-Profit Organization Systems. *Information, 13*(8), 374. doi: https://doi.org/10.3390/info13080374

Alshammeri, M., Atwell, E., & ammar Alsalka, M. (2021). Detecting semantic-based similarity between verses of the Quran with Doc2vec. *Procedia Computer Science, 189*, 351-358. doi:https://doi.org/10.1016/j.procs.2021.05.104

Amir, H. F., Huda, A., & Maksum, H. (2020). Development of mobile learning for simulation and digital communications. *Journal of Education Technology, 4*(3), 310-316. doi:https://doi.org/10.23887/jet.v4i3.28537

Anthis, J. R., & Paez, E. (2021). Moral circle expansion: A promising strategy to impact the far future. *Futures, 130*, 102756. doi:https://doi.org/10.1016/j.futures.2021.102756

Aryan, A., Bosché, F., & Tang, P. (2021). Planning for terrestrial laser scanning in construction: A review. *Automation in Construction, 125*, 103551. doi:https://doi.org/10.1016/j.autcon.2021.103551

Balakrishnan, J., & Dwivedi, Y. K. (2024). Conversational commerce: entering the next stage of AI-powered digital assistants. *Annals of Operations Research, 333*(2), 653-687. doi:https://doi.org/10.1007/s10479-021-04049-5

Bao, H., Zhang, C., & Gao, S. (2022). Design and analysis of joint source-channel code system with fixed-length code. *Information, 13*(6), 281. doi: https://doi.org/10.3390/info13060281

Bayuo, J., Nyande, F. K., Awunyo, W., & Akpalu, E. (2025). The longitudinal qualitative research design in nursing, health, and social care research: philosophy, methodology, and methods. *BMC Medical Research Methodology, 26*(1), 2. doi:https://doi.org/10.1186/s12874-025-02736-6

Bent, B., Goldstein, B. A., Kibbe, W. A., & Dunn, J. P. (2020). Investigating sources of inaccuracy in wearable optical heart rate sensors. *NPJ digital medicine, 3*(1), 18. doi:https://doi.org/10.1038/s41746-020-0226-6

Bezuidenhout, L., Thurston, C., Hagströmer, M., & Moulaee Conradsson, D. (2021). Validity of hip and ankle worn actigraph accelerometers for measuring steps as a function of gait speed during steady state walking and continuous turning. *Sensors, 21*(9), 3154. doi:https://doi.org/10.3390/s21093154

Bhowmick, S., Kundu, P. K., & Mandal, D. D. (2021). *IoT-Based Real-Time HRV Performance Analysis.* Paper presented at the Proceedings of International Conference on Advanced Computing Applications: ICACA 2021.

Bressan, V., Hansen, H., Koldby, K., Andersen, K. D., Snijder, A., Tageo, V., García, A. (2021). Needs, issues, and expectations on dementia care at home across Europe to inform policy development: Findings from a transnational research study. *Health Policy, 125*(8), 1013-1022. doi:https://doi.org/10.1016/j.healthpol.2021.05.012

Bui, S. (2021). Enacting transitions the combined effect of multiple niches in whole system reconfiguration. *Sustainability, 13*(11), 6135. doi:https://doi.org/10.3390/su13116135

Carnevale, A., Tangari, E. A., Iannone, A., & Sartini, E. (2023). Will Big Data and personalized medicine do the gender dimension justice? *ai & Society, 38*(2), 829-841. doi:https://doi.org/10.1007/s00146-021-01234-9

Chow-White, P. A., Deveau, D., & Adams, P. (2015). Media encoding in science fiction television: Battlestar Galactica as a site of critical cultural production. *Media, Culture & Society, 37*(8), 1210-1225. doi:https://doi.org/10.1177/0163443715594031

Crescentini, N., & Punziano, G. (2026). Elicitation as challenge in social research: evolution, frontiers and perspective. *SN Social Sciences, 6*(2), 58. doi:https://doi.org/10.1007/s43545-026-01344-5

Creswell, J. W., & Creswell, J. D. (2018). *Research design: Qualitative, quantitative, and mixed methods approaches*: Sage publications.
Felius, R. A., Geerars, M., Bruijn, S. M., van Dieën, J. H., Wouda, N. C., & Punt, M. (2022). Reliability of IMU-based gait assessment in clinical stroke rehabilitation. *Sensors, 22*(3), 908. doi:https://doi.org/10.3390/s22030908
Feng, X., Chen, J., & Niu, T. (2022). Singularity-Free Fixed-Time Adaptive Control with Dynamic Surface for Strict-Feedback Nonlinear Systems with Input Hysteresis. *Electronics, 11*(15), 2378. doi:https://doi.org/10.3390/electronics11152378
Fernández Fortunato, E., Jiménez-Sáez, F., & Hontoria, E. (2023). Can industry counteract the ecological crisis? An approach for the development of a new circular bioeconomic model based on biocomposite materials. *Sustainability, 15*(4), 3382. doi:https://doi.org/10.3390/su15043382
Flower, L., & Ahlefeldt, M.-S. (2021). The criminal trial as a live event: Exploring how and why live blogs change the professional practices of judges, defence lawyers and prosecutors. *Media, Culture & Society, 43*(8), 1480-1496. doi:https://doi.org/10.1177/01634437211022730
Galnares, M., Nesmachnow, S., & Simini, F. (2021). Instance-based learning following physician reasoning for assistance during medical consultation. *Applied Sciences, 11*(13), 5886. doi: https://doi.org/10.3390/app11135886
Gaspar, T., Correia, M. F., & Torres, I. (2021). Perception of management and public health experts about organizational, professionals and patients related factors that influence the performance in health organizations. *Procedia Computer Science, 181*, 166-172. doi:https://doi.org/10.1016/j.procs.2021.01.117
Grinschgl, S., Meyerhoff, H. S., & Papenmeier, F. (2020). Interface and interaction design: How mobile touch devices foster cognitive offloading. *Computers in human behavior, 108*, 106317. doi:https://doi.org/10.1016/j.chb.2020.106317
Gupta, A., Khan, H. U., Nazir, S., Shafiq, M., & Shabaz, M. (2023). Metaverse security: Issues, challenges and a viable ZTA model. *Electronics, 12*(2), 391. doi:https://doi.org/10.3390/electronics12020391
Hamza, M. H., & Saegh, A. M. (2023). Flash flood risk assessment due to a possible dam break in urban arid environment, the new Um Al-Khair Dam case study, Jeddah, Saudi Arabia. *Sustainability, 15*(2), 1074. doi:https://doi.org/10.3390/su15021074
Huang, J., Hao, T., Wang, Y., & Jones, P. (2022). A street-scale simulation model for the cooling performance of urban greenery: Evidence from a high-density city. *Sustainable Cities and Society, 82*, 103908. doi:https://doi.org/10.1016/j.scs.2022.103908
Idkhajine, L., Aarab, M., & Monmasson, E. (2023). System identification–based adaptive real-time simulators for power electronic converters—Application to three-phase and NPC inverters. *Electronics, 12*(5), 1094. doi:https://doi.org/10.3390/electronics12051094
Iqbal, S., & Bhatti, Z. A. (2020). A qualitative exploration of teachers' perspective on smartphones usage in higher education in developing countries. *International Journal of Educational Technology in Higher Education, 17*(1), 29. doi:https://doi.org/10.1186/s41239-020-00203-4
Irfan, M., Jiangbin, Z., Ali, S., Iqbal, M., Masood, Z., & Hamid, U. (2021). DeepShip: An underwater acoustic benchmark dataset and a separable convolution based autoencoder for classification. *Expert Systems with Applications, 183*, 115270. doi:https://doi.org/10.1016/j.eswa.2021.115270
James, E., & Mendlesohn, F. (2003). *The Cambridge companion to science fiction*: Cambridge University Press.
Jaylo, J. R., Chastain, M., Nemec, A., Ouch, C. S., Asefa, Y., Li, M., Trujillo, C. M. (2026). Visualization use in qualitative research reports: Evolving media types and competing epistemologies. *ArXiv Preprint*. doi:https://doi.org/10.48550/ARXIV.2603.27849
Jena, G., Vashisht, M., Basu, A., Ungar, L., & Sedoc, J. (2017). Enterprise to computer: Star trek chatbot. *arXiv preprint arXiv:1708.00818*. doi:https://doi.org/10.48550/ARXIV.1708.00818
Jin, Q., Mu, C., Tian, L., & Ran, F. (2020). A region generation based model for occluded face detection. *Procedia Computer Science, 174*, 454-462. doi:https://doi.org/10.1016/j.procs.2020.06.114
Kennedy, L., Sood, A., Chakraborty, D., & Chitta, R. M. (2022). Interrogating data justice on Hyderabad's urban frontier: Information politics and the internal differentiation of vulnerable

communities. *Information, Communication & Society, 25*(9), 1273-1292. doi:https://doi.org/10.1080/1369118X.2020.1851388
Kim, C.-H., Jung, J., Lee, Y.-u., Kim, K.-h., Kang, S., Kang, G.-h., Lee, S. (2022). *Comparison of metabolites and gut microbes between patients with Parkinson's disease and healthy individuals—a pilot clinical observational study (STROBE Compliant).* Paper presented at the Healthcare.
Kim, S.-H., Chuang, H.-R., Lyerly, R., Olivier, P., Min, C., & Ravindran, B. (2020). *DEX: scaling applications beyond machine boundaries.* Paper presented at the 2020 IEEE 40th International Conference on Distributed Computing Systems (ICDCS).
Ko, Y. (2022). Survey of software-implemented soft error protection. *Electronics, 11*(3), 456. doi:https://doi.org/10.3390/electronics11030456
Krausz, A. D., Korley, F. K., & Burns, M. A. (2021). A variable height microfluidic device for multiplexed immunoassay analysis of traumatic brain injury biomarkers. *Biosensors, 11*(9), 320. doi:. https://doi.org/10.3390/bios11090320
Lahlou, L., Kara, N., & Edstrom, C. (2022). Davinci: online and dynamic adaptation of evolvable virtual network services over cloud infrastructures. *Future Generation Computer Systems, 127*, 396-408. doi:https://doi.org/10.1016/j.future.2021.09.017
Le, V. X., Lee, H., Pham, N. S., Bong, S., Oh, H., Cho, S.-H., & Shin, I.-S. (2021). Stainless steel 304 needle electrode for precise glucose biosensor with high signal-to-noise ratio. *Sensors and Actuators B: Chemical, 346*, 130552. doi:https://doi.org/10.1016/j.snb.2021.130552
Lee, S., Shi, C.-K., & Doh, Y. Y. (2021). The relationship between co-playing and socioemotional status among older-adult game players. *Entertainment Computing, 38*, 100414. doi:https://doi.org/10.1016/j.entcom.2021.100414
Li, Q., Liu, P., Wang, Z., & Li, X. (2023). Vibration therapy to improve pain and function in patients with chronic low back pain: a systematic review and meta-analysis. *Journal of orthopaedic surgery and research, 18*(1), 727. doi:https://doi.org/10.1186/s13018-023-04217-2
Li, S., Zhang, H., Liu, Z., Xu, J., Fan, G., Li, W., Jing, G. (2022). Auger Electron Spectroscopy (AES) and X-ray Photoelectron Spectroscopy (XPS) Profiling of Self Assembled Monolayer (SAM) Patterns Based on Vapor Deposition Technique. *Applied Sciences, 12*(3), 1245. doi:https://doi.org/10.3390/app12031245
Lindsay, S. M. (2022). The "problem" of multispecies families: Speciesism in emergency intimate partner violence (IPV) shelters. *Social Sciences, 11*(6), 242. doi:https://doi.org/10.3390/socsci11060242
Liu, P.-Y., Ko, W.-C., Lee, W.-S., Lu, P.-L., Chen, Y.-H., Cheng, S.-H., Yen, M.-Y. (2022). In vitro activity of cefiderocol, cefepime/enmetazobactam, cefepime/zidebactam, eravacycline, omadacycline, and other comparative agents against carbapenem-non-susceptible Pseudomonas aeruginosa and Acinetobacter baumannii isolates associated from bloodstream infection in Taiwan between 2018–2020. *Journal of Microbiology, Immunology and Infection, 55*(5), 888-895. doi:https://doi.org/10.1016/j.jmii.2021.08.012
Martin, J. (2025). 10 Key Consumer Behavior Trends (2025 & 2026). Retrieved from https://explodingtopics.com/blog/consumer-behavior
Mcardle, M. (2016). This Is How Star Trek Invented Fandom. Retrieved from https://www.gq.com/story/this-is-how-star-trek-invented-fandom
Mugambi, P., Blanco, M., Ogachi, D., Ferasso, M., & Bares, L. (2021). Analysis of the regional efficiency of european funds in Spain from the perspective of renewable energy production: The regional dimension. *International Journal of Environmental Research and Public Health, 18*(9), 4553. doi:https://doi.org/10.3390/ijerph18094553
Murphy, K., & Creux, O. (2021). Examining the association between media multitasking, and performance on working memory and inhibition tasks. *Computers in Human Behavior, 114*, 106532. doi:https://doi.org/10.1016/j.chb.2020.106532
Mutanana, N., & Shoko, C. T. (2026). Addressing the efficacy of quality in qualitative research: a review of the current discourse. *International Journal of Qualitative Methods, 25*, 16094069261432368. doi: https://doi.org/10.1177/16094069261432368

Nelke, K., Łuczak, K., Janeczek, M., Pasicka, E., Żak, K., Łukaszewski, M., . . . Dobrzyński, M. (2023). Fresh–frozen allogenic bone graft usage in treatment of an odontogenic keratocyst in the mandible. *Applied Sciences, 13*(3), 1234. doi:https://doi.org/10.3390/app13031234

Nicholas, E., Ozioko, E., & Nwigwe, J. (2022). Understanding the General Framework for Teaching Semantics and Syntaxes of Visual Languages to Computer Education Students Based on Notion of Abstract Visual Syntax Graphs *Proceedings of the Computational Methods in Systems and Software* (Vol. 579, pp. 1-21): Springer.

Nurjaya, M., Maulana, Y., Maulida, I. S., & Laratmase, A. J. (2024). The impact of multimedia elements on tablets and digital stories in learning process management. *Journal of Education Technology, 8*(1), 136-146. doi: https://doi.org/10.23887/jet.v8i1.71326

Okayama, A., Nakayama, N., Kashiwa, K., Horinouchi, Y., Fukusaki, H., Nakamura, H., & Katayama, S. (2022). *Prevalence of sarcopenia and its association with quality of life, postural stability, and past incidence of falls in postmenopausal women with osteoporosis: a cross-sectional study.* Paper presented at the Healthcare.

Omidi, A., Jahangiri, M., Mohammadidehcheshmeh, F., & Mostafaeipour, A. (2021). Comprehensive assessment of agricultural waste effect on the thermal bridge phenomenon using ZUB ARGOS software, a case study in Iran. *Energy and Buildings, 245*, 111089. doi:https://doi.org/10.1016/j.enbuild.2021.111089

Ortiz, G. I. J., Graziano, M. F., & Ewig, G. T. (2020). Presentación al dossier "Adolescencia y justicia. Una mirada a los sistemas de justicia juvenil latinoamericanos". *Revista NuestrAmérica, 8*(15), 4-7.

Oyibo, K., & Vassileva, J. (2021). Relationship between perceived UX design attributes and persuasive features: a case study of fitness app. *Information, 12*(9), 365. doi:https://doi.org/10.3390/info12090365

Paredes-Frigolett, H., Pyka, A., & Leoneti, A. B. (2021). On the performance and strategy of innovation systems: A multicriteria group decision analysis approach. *Technology in Society, 67*, 101632. doi:https://doi.org/10.1016/j.techsoc.2021.101632

Pinto-Ferreira, F., Mitsuka-Breganó, R., Monica, T. C., Martins, F. D. C., Matos, R. L. N. d., Mareze, M., Navarro, I. T. (2019). Investigation and environmental analysis of samples from outbreak of toxoplasmosis at research institution in Londrina, Paraná, Brazil, 2016. *Revista Brasileira de Parasitologia Veterinária, 28*(3), 518-521. doi:https://doi.org/10.1590/s1984-29612019044

Pogue, D. (2018). How Good Is Star Trek's Record at Predicting the Future of Tech? [Scientificamerican]. How Good Is Star Trek's Record at Predicting the Future of Tech? Retrieved from https://www.scientificamerican.com/article/how-good-is-star-treks-record-at-predicting-the-future-of-tech

Poth, C. N., & Shannon-Baker, P. (2022). State of the methods: Leveraging design possibilities of qualitatively oriented mixed methods research. *International Journal of Qualitative Methods, 21*, 16094069221115302. doi:https://doi.org/10.1177/16094069221115302

Rainarli, E. (2021). A decade: Review of scene text detection methods. *Computer Science Review, 42*, 100434. doi:https://doi.org/10.1016/j.cosrev.2021.100434

Rismani, S., Shelby, R., Smart, A., Delos Santos, R., Moon, A., & Rostamzadeh, N. (2023). *Beyond the ml model: Applying safety engineering frameworks to text-to-image development.* Paper presented at the Proceedings of the 2023 AAAI/ACM Conference on AI, Ethics, and Society.

Rodrigues, C., Souza, V. G. L., Coelhoso, I., & Fernando, A. L. (2021). Bio-based sensors for smart food packaging current applications and future trends. *Sensors, 21*(6), 2148. doi: https://doi.org/10.3390/s21062148

Saitov, I., Polevaya, T., & Filchenkov, A. (2020). Dermoscopic attributes classification using deep learning and multi-task learning. *Procedia Computer Science, 178*, 328-336. doi:https://doi.org/10.1016/j.procs.2020.11.034

Seng, K. P., Ang, L.-M., Peter, E., & Mmonyi, A. (2023). Machine learning and AI technologies for smart wearables. *Electronics, 12*(7), 1509. doi: https://doi.org/10.3390/electronics12071509

Shi, W., Haga, A., & Okada, Y. (2021). Web-based 3D and 360∘ VR materials for iot security education and test supporting learning analytics. *Internet of Things, 15*, 100424. doi: https://doi.org/10.1016/j.iot.2021.100424

Skulinová, K., Novák, J., Kolářová, L., & Kašný, M. (2022). Antigenic Proteins from the Excretory–Secretory Products of Toxocara canis Larvae and Evaluation of Their Potential for Immunodiagnostics of Larval Toxocarosis. *Acta Parasitologica, 67*(2), 705-713. doi:https://doi.org/10.1007/s11686-021-00485-2

Sodhro, A. H., Awad, A. I., van de Beek, J., & Nikolakopoulos, G. (2022). Intelligent authentication of 5G healthcare devices: A survey. *Internet of Things, 20*, 100610. doi:https://doi.org/10.1016/j.iot.2022.100610

Soundy, A. (2026). "What the Meta Is Going On?"—A Scoping Review of the Different Methods and Methodology of Qualitative Synthesis. *Lifespan Development and Mental Health, 2*(1), 10003. doi:https://doi.org/10.70322/ldmh.2026.10003

Space, J. (2021). 55 Years Ago: Star Trek Debuts, Begins an Enduring Relationship with NASA. Retrieved from https://www.nasa.gov/history/55-years-ago-star-trek-debuts-begins-an-enduring-relationship-with-nasa

Stokes, I. (2026). Star Trek:' History & effect on space technology [Space]. Retrieved from https://www.space.com/31802-star-trek-space-tech.html

Su, C.-W., Yuan, X., Umar, M., & Lobonţ, O.-R. (2022). Does technological innovation bring destruction or creation to the labor market? *Technology in Society, 68*, 101905. doi:https://doi.org/10.1016/j.techsoc.2022.101905

Tan, Z., Wang, S., Yang, Z., Chen, G., Huang, X., Sun, M., & Liu, Y. (2020). Neural machine translation: A review of methods, resources, and tools. *AI Open, 1*, 5-21. doi:https://doi.org/10.1016/j.aiopen.2020.11.001

Taneja, S. B., Callahan, T. J., Paine, M. F., Kane-Gill, S. L., Kilicoglu, H., Joachimiak, M. P., & Boyce, R. D. (2023). Developing a knowledge graph for pharmacokinetic natural product-drug interactions. *Journal of biomedical informatics, 140*, 104341. doi:https://doi.org/10.1016/j.jbi.2023.104341

Taylor, M. (2018). Let's face it, technological determinism is terrible politics [Wired]. . Retrieved from https://www.wired.com/story/technological-determinism-politics

Tigga, N. P., & Garg, S. (2020). Prediction of type 2 diabetes using machine learning classification methods. *Procedia Computer Science, 167*, 706-716. doi:https://doi.org/10.1016/j.procs.2020.03.336

Varma, D. S., Nandanan, K., PC, V. R., Pérez, M. L., KA, S., & Ramesh, M. V. (2021). Participatory design approach to address water crisis in the village of Karkatta, Jharkhand, India. *Technological Forecasting and Social Change, 172*, 121002. doi:https://doi.org/10.1016/j.techfore.2021.121002

Wang, P., Li, P., Li, Y., Wang, J., & Xu, J. (2021). Histopathological image classification based on cross-domain deep transferred feature fusion. *Biomedical signal processing and control, 68*, 102705. doi:https://doi.org/10.1016/j.bspc.2021.102705

Wen, W., Liu, Y., Ouyang, C., Lin, Q., & Chung, T. (2021). Enhanced prototypical network for few-shot relation extraction. *Information Processing & Management, 58*(4), 102596. doi:https://doi.org/10.1016/j.ipm.2021.102596

William. (2026). Determinism. Retrieved from https://www.britannica.com/topic/determinism

Wutich, A., Beresford, M., & Bernard, H. R. (2024). Sample sizes for 10 types of qualitative data analysis: an integrative review, empirical guidance, and next steps. *International Journal of Qualitative Methods, 23*, 16094069241296206. doi: https://doi.org/10.1177/16094069241296206

Yang, S. (2025). *Application and Trend Analysis of Digital Marketing in Health Industry*. Paper presented at the SHS Web of Conferences.

Ye, T., Luo, M., Yang, Y., Choo, K.-K. R., & He, D. (2023). A survey on redactable blockchain: Challenges and opportunities. *IEEE Transactions on Network Science and Engineering, 10*(3), 1669-1683. doi:https://doi.org/10.1109/TNSE.2022.3233448

Yeung, W.-L., & Ng, O.-L. (2023). Characterizing touchscreen actions in technology-enhanced embodied learning for mathematics instruction in K-12 setting–A systematic review (2010–2023). *Computers & Education, 205*, 104881. doi:https://doi.org/10.1016/j.compedu.2023.104881

Zanelli, F., Mauri, M., Castelli-Dezza, F., Sabbioni, E., Tarsitano, D., & Debattisti, N. (2022). Energy autonomous wireless sensor nodes for freight train braking systems monitoring. *Sensors, 22*(5), 1876. doi:https://doi.org/10.3390/s22051876

Zheng, J., & Li, S. (2020). What drives students' intention to use tablet computers: An extended technology acceptance model. *International Journal of Educational Research, 102*, 101612. doi: https://doi.org/10.1016/j.ijer.2020.101612