

## Spatial.io in English Language Learning: Non-English Majors' Perceptions of Virtual Space in the Metaverse

Nita Sari Narulita Dewi<sup>1</sup>, Yusup Supriyono<sup>2</sup>, Ratu Sarah Pujasari<sup>3</sup>, Muhammad Adlan Faishal<sup>4</sup>,  
 Luis Luigi Eugenio A. Valencia<sup>5</sup>, Santiana Santiana<sup>6</sup>  
 Universitas Siliwangi, Indonesia<sup>1,2,3,4,6</sup>  
 Leyte Normal University, Philippines<sup>5</sup>  
 Email Correspondence: nitasarinarulitadewi@unsil.ac.id

### Abstract

**Background:**

Despite the promise of immersive education for metaverses, empirical evidence regarding the specific role in English language learning for non-English majors remains scarce. This study addresses the gap by examining students' perceptions of the metaverse platform, Spatial.io, to inform more inclusive teaching strategies.

**Methodology:**

This study employed a qualitative case study design. Semi-structured interviews were conducted with four non-English major students selected to provide insight into early user experiences, and thematic analysis was utilized to interpret the interview data.

**Findings:**

Drawing on the Technology Acceptance Model (TAM), the analysis revealed three key themes. First, regarding perceived usefulness, participants reported that the metaverse enhanced interactivity, collaboration, and English language skills through immersive features. Second, perceived ease of use attributed to the platform's flexibility and intuitive interface. However, significant challenges identified regarding technical infrastructure, internet instability and device compatibility, which hindered equitable access.

**Conclusion:**

The metaverse shows promise as a supplementary tool for enhancing English language skills development. However, because this study only involved a small group of students, these results are preliminary. Future implementation implies the needs for improved infrastructure and hardware compatibility to ensure inclusive learning environment.

**Originality:**

This study provides a closer look at how non-English majors perceive the metaverse (Spatial.io), offering early insight into how this technology might change language education before it is widely adopted.

|                                       |                                                                                                                                                                                                                                                                                                                                                                                                               |
|---------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Keywords</b>                       | : Metaverse; Technology Enhanced Language Learning; Perception                                                                                                                                                                                                                                                                                                                                                |
| <b>DOI</b>                            | : 10.24903/sj.v11i2.1892                                                                                                                                                                                                                                                                                                                                                                                      |
| <b>Received</b>                       | : November 2024                                                                                                                                                                                                                                                                                                                                                                                               |
| <b>Accepted</b>                       | : September 2025                                                                                                                                                                                                                                                                                                                                                                                              |
| <b>Published</b>                      | : October 2025                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>How to cite this article (APA)</b> | Dewi, N. S. N., Supriyono, Y., Pujasari, R. S., Faishal, M. A., Valencia, L. L. E. A., & Santiana, S. (2025). Spatial.io in English language learning: Non-English majors' perceptions of virtual space in the metaverse. <i>Script Journal: Journal of Linguistics and English Teaching</i> , 11(2), 370-380.<br><a href="https://doi.org/10.24903/sj.v11i2.1892">https://doi.org/10.24903/sj.v11i2.1892</a> |
| <b>Copyright Notice</b>               | Authors retain copyright and grant the journal right of first publication with the work simultaneously licensed under a <b>Creative Commons Attribution 4.0 International License</b> that allows others to share the work with an acknowledgement of the work's authorship and initial publication in this journal.<br>   |

## 1. INTRODUCTION

English proficiency is essential for students who are not English majors because it supports their academic requirements, future careers, and social communication needs. In today's globalized world, English mastery is often a prerequisite for higher education and employment opportunities, while oral proficiency plays a vital role in advancing communication skills (Wang et al., 2022). For non-English majors, developing English competence is not merely an academic requirement but also a strategic asset for professional growth and participation in English-speaking communities. As non-English majors continue to face challenges in maintaining consistent language practice and motivation, integrating innovative technologies into language instruction has become increasingly relevant.

The integration of technology into language learning has been widely promoted as a way to enrich students' learning experiences. Recently, the "metaverse" has gained attention as an emerging educational technology that merges real and virtual environments to create immersive learning experiences. Metaverse-based language learning allows learners to access virtual materials, interact through digital avatars, and engage in nearly natural communication beyond the constraints of traditional classrooms (Fatimah & Santiana, 2017; Li & Yu, 2023; Puncreobutr et al., 2022; Nur et al., 2023; Santiana et al., 2024). These interactive environments can foster learner engagement, cultural awareness, self-confidence, and collaboration, which are crucial for effective English learning (Aydm, 2022).

Despite these potentials, research on metaverse-based education in the context of English as a Foreign Language (EFL) remains limited. Previous studies have highlighted the lack of comprehensive investigations into the integration of metaverse platforms into English language learning (Reisoğlu et al., 2017; Tlili et al., 2022). Particularly, there is insufficient empirical evidence regarding assessment practices, learner engagement, and activity design in metaverse environments (İbili et al., 2024). Existing research has largely focused on English language learners, thus lacking an understanding of how non-English learners perceive and utilize metaverse platforms (Pujasari et al., 2024; Li & Yu, 2023). Moreover, the adaptability of specific metaverse features, such as simulated characters and real-time interactions, to meet the learning needs of non-English learners has not been systematically explored.

Therefore, this study addresses this gap by examining non-English majors' perceptions of metaverse-based English language learning. Specifically, it investigates how these learners experience the benefits and challenges of using the metaverse for language learning. Addressing this gap is crucial to understanding the inclusivity and pedagogical value of metaverse technologies beyond English major contexts. By doing so, the study aims to provide

insights that can inform pedagogical practices and enhance student engagement in diverse educational contexts. The research question posed is: *How do non-English major students perceive the use of metaverse technology in learning English as a foreign language?*

The findings are expected to extend current understanding of immersive learning and inform future pedagogical frameworks for technology-enhanced EFL instruction.

## 2. METHODOLOGY

This study employed a qualitative case study design to explore non-English major students' perceptions of using metaverse technology in learning English. A Case study was considered appropriate because it enables in-depth investigation of a bounded system, in this case, a group of learners who used the metaverse platform, Spatial.io (<https://www.spatial.io>) as part of their learning activities (Yin, 2018).

The participants were selected through purposive sampling, with the criteria that they were undergraduate students from non-English majors, had experience using the metaverse platform, Spatial.io for English learning, and were willing to participate. Four students, three males and one female, from Indonesian Education Department were recruited. Their ages ranged between 19-21 years old. Although the sample size was small, it allowed for rich, detailed accounts of individual experiences. In qualitative research, particularly in studies with a homogeneous population and focused scope, small sample are acceptable when the aim is to obtain depth rather than breadth, and data sufficiency was reached as no new themes emerged across participants (Guest et al., 2006; Hennink & Kaiser, 2022).

In collecting data, all participants were informed about the purpose of the study and signed consent forms prior to data collection. Participation was voluntary, and they were assured about confidentiality by using pseudonyms in the reporting of findings, and no personally identifiable information was disclosed.

The data were collected through individual semi-structured interviews conducted either in person or via an online platform. The semi-structured interview format was chosen to allow for flexibility in probing key themes related to the research objectives. Each interview lasted between 45-60 minutes and was audio-recorded with participants' consent. The interview protocol was developed based on the Technology Acceptance Model (Davis, 1989), focusing on participants' perceived benefits, ease of use, and challenges of metaverse integration in English language learning.

Data were analyzed using six phases of thematic analysis (Braun & Clarke, 2006): (1) familiarization with the data by transcribing and re-reading interview records; (2) generating

initial codes by highlighting meaningful segments related to perceptions of metaverse learning; (3) searching for potential themes; (4) reviewing themes for coherence and distinctiveness; (5) defining and naming themes to capture their essence; and (6) producing a final thematic map supported with excerpts.

### **3. FINDINGS**

The findings are presented according to the Technology Acceptance Model (TAM), which guided the analysis. Three constructs were used, perceived usefulness, perceived ease of use and challenges. Within these constructs, several themes emerged from the data.

#### **3.1 Perceived Usefulness**

##### **3.1.1 Increasing Interactivity and Collaboration**

Participants consistently highlighted the metaverse as a tool that enhanced interactivity and collaboration in English language learning. Features such as virtual classroom, digital projector, and presentation tools were perceived to stimulate real-life learning environment, thereby increasing engagement in discussion and group tasks.

*“Within the metaverse, there are many features that aid in English language learning, such as online classes and projectors that depict an actual learning space. We can also interact and collaborate, such as during presentations, which can enhance the English learning experience” (P1).*

*“Learning conducted in the metaverse is done class by class, thereby increasing the level of interactivity in discussion sessions... This leads to collaborative learning as diverse opinions from each individual are shared, complementing one another (P2).”*

*“Learning in the metaverse can connect people from anywhere, allowing for interaction and collaboration within it (P4).”*

##### **3.1.2 Enhancing Learning Experience and Communication**

Beyond fostering collaboration, the metaverse was also seen as enriching the learning experience and creating opportunities to practice communication in a more engaging way.

*“The metaverse can enhance the learning experience and practice of communicating in English with friends interactively. This application presents an engaging virtual English class (P1).”*

*“Spatial.io gives me a new experience in learning English, making me more enthusiastic about studying, which helps me learn English better (P3).”*

##### **3.1.3 English Skills Development**

Participants also recognized that the platform supported the development of multiple English skills. For example, the chat function encouraged writing practice while avatar customization and visual features introduced new vocabulary items. In addition, the voice note function provided opportunities to practice speaking and listening.

*"In the metaverse, we can use the chat feature, which provides an opportunity to be more creative in using our English skills... the voice note feature allows us to practice speaking English in the metaverse, honing our speaking ability" (P1).  
"...in my opinion, this is sufficient to improve my English... the metaverse is very impactful for learning (P2)."  
"I think in the Spatial metaverse, the listening skills are more practiced... making it even more interesting (P3)."  
"In addition to gaining a learning experience, another advantage of using the metaverse is that we can hone our skills and learn in a more creative and interactive way (P4)."*

Overall, the metaverse was perceived as a useful tool that promoted engagement, enhanced communication, and supported skill development in an integrated manner.

### **3.2 Perceived Ease of Use: Accessibility and Flexibility, User-friendly Interface**

There is an implicit perception that the features of the metaverse are well-designed to support learning, indicating ease of use. All four participants reported that the platform was accessible and user-friendly. They valued the resemblance of virtual classrooms to physical ones and the intuitive navigation features.

*"For me personally, navigation in the metaverse poses no challenges at all; the network is stable... it is very easy to access (P1)."  
"The metaverse is easy to use for learning English due to its flexible access (P2)."  
"I did not encounter any difficulties while using the metaverse to learn English (P3)."  
"The metaverse is easy to use for learning English because access is flexible, and learning can be demonstrated directly through its features (P4)."*

Ease of use was also associated with flexibility, as students could join from various locations. However, this perception was not uniform. While participants agree the platform itself was intuitive, some emphasized that ease of use depended heavily on prior familiarity with digital platforms. Students who were less technologically confident might find it more demanding, suggesting that training or orientation could enhance accessibility further.

### **3.3 Challenges: Internet connectivity issue, Device Compatibility**

Despite positive perceptions, participants also identified significant challenges. The most frequently cited barrier was the instability of internet connection, which sometimes disrupted communication and group activities.

*"...because internet connections or signal strength vary among individuals, this is considered less effective (P1)."  
"The metaverse is easy to use for learning English due to its flexible access. However, some of my friends find it difficult due to unstable signal (P2)."*

Another concern was the variation in hardware compatibility. Students with lower specification devices reported lagging and reduced functionality compared to peers with newer devices.

*“A challenge in using the metaverse/Spatial.io is the network issues and different phone specifications among users; some are compatible while others are not (P3).”*

These limitation highlights inequalities in access and suggest that, despite its usefulness, the metaverse cannot fully replace conventional learning unless infrastructure issues are addressed

**Table 1. Mapping of TAM Constructs and Emerging Themes**

| TAM Construct         | Emerging Themes                           | Illustrative Examples                           |
|-----------------------|-------------------------------------------|-------------------------------------------------|
| Perceived Usefulness  | Interactivity & collaboration             | Virtual classes, presentations, peer discussion |
|                       | Enhanced learning experience & motivation | “More enthusiastic about studying” (P3)         |
|                       | English skill development                 | The voice note feature for speaking (P1)        |
| Perceived Ease of Use | Accessibility & flexibility               | “Navigation poses no challenges” (P1)           |
|                       | User-friendly interface                   | Resemblance to real classrooms                  |
| Challenges            | Internet connectivity issues              | “Signal strength varies among individuals” (P1) |
|                       | Device compatibility                      | Differences in phone specifications (P3)        |

In summary, the study shows that non-English majors perceive metaverse-based English learning useful and engaging, particularly in enhancing interactivity, collaboration, learning experience, motivation, and English skill development. The platform was generally regarded as easy to use though this perception varied according to students' digital competence. Importantly, challenges such as connectivity problems and hardware disparities emerged as critical barriers that could hinder equitable access. These findings suggest that while the metaverse has strong potential as a supplementary language learning tool, institutional and infrastructural support is essential for its sustainable implementation.

#### 4. DISCUSSION

The study explored non-English students' perceptions of the metaverse platform, Spatial.io, in English language learning. The findings generally indicate positive perceptions, with participants highlighting interactivity, collaboration, learning experience, motivation, and

English skill development as key benefits. However, rather than merely confirming prior studies, these findings can be interpreted in several nuanced ways

First, the use of metaverse as an interactive and collaborative platform reflect a growing trend in higher education toward immersive learning environments. Its features allow for a learning environment similar to real classrooms so that it enhances students' engagement in discussion and group work. It aligns with Lyu's findings that advanced technology and reliable real-time communication in the Metaverse enable smooth high-definition video conferencing and enhance better collaboration among users (Lyu, 2023). Moreover, it is designed for social interaction and collaboration, promoting cooperative behavior by providing a virtual environment where individuals can work together effectively, leading to improved teamwork outcomes (Hennig-Thurau et al., 2023; Santiana, et al., 2024). In line with Khaira et al. (2024), these findings suggest that the metaverse can transform conventional EFL classrooms by fostering "embodied interaction" through avatars and spatial design, an element that deserves more attention in discussions of learner engagement.

Second, participants perceived the metaverse, Spatial.io, as enhancing their students' learning experience and communication. According to Zhang et al. (2022), metaverse can give a more immersive learning experience by combining visual, aural, and tactile aspects. This platform also allows students to practice communicating in English in a more creative atmosphere. Participants feel that the metaverse provides a more enjoyable and motivating way to learn, due to its interactive virtual environment. The features in the metaverse also enable participants to learn more creatively, making the English learning process more appealing. As stated by Kim (2023), Metaverse creates a virtual space where students can interact through avatars, simulating real-world communication scenarios. This setting allows students to practice speaking in a more relaxed and engaging setting, which can reduce the anxiety associated with public speaking. In addition, it encourages active peer-to-peer communication by allowing students to collaborate and converse with each other in real time. This interaction is essential for developing language skills, as it mimics the dynamics of natural conversation and helps learners improve their speaking skills through practice (Gualano & Campbell, 2024).

Third, participants associated the metaverse, Spatial.io, with the development of various English skills, including writing, speaking, and vocabulary, through interactive features such as chat, voice notes, and character visualization. This echoes prior findings by Hatmanto et al. (2023) and Jiao et al. (2024) that the metaverse enables students to participate in collaborative writing tasks in a virtual setting. This setting promotes real-time feedback and

peer engagement (Santiana, et al., 2021), both of which are necessary for the development of writing skills. By offering a secure environment where practice can be done without worrying about criticism, this experiential learning promotes confidence and fluency (Li & Yu, 2023).

Besides perceived usefulness, implicitly, the non-English students perceived that the metaverse offers flexible and user-friendly access, especially for those familiar with technology. This aligns with findings from Al-kfairy et al. (2024) who emphasize that although the metaverse is easy to use, it should be noted that some challenges, such as interoperability issues and hardware limitations still exist, which require further development and improvement. Thus, the issues should be the concern of educators as well as institutions to create better learning and, in the end, maintain learning effectiveness.

In addition, although participants generally perceived the platform as flexible and user-friendly, they also encountered technical issues such as connectivity and hardware limitations. These findings resonate with broader debates on digital readiness, infrastructure inequality, and institutional responsibility. For example, students from less technologically privileged backgrounds may struggle to access the full benefits of metaverse-based learning, raising questions about digital equity in higher education.

## 5. CONCLUSION

The findings reveal that students perceive the metaverse, particularly through Spatial.io, as a valuable platform that contributes positively to their English language learning. The metaverse significantly increases interactivity and collaboration, providing a dynamic learning environment that simulates real-world classroom experiences. Participants noted improvements in their learning experiences and communication skills, highlighting the engaging nature of the platform. Moreover, through its interactive and immersive features, the metaverse demonstrates the capability to enhance various English skills, including writing, speaking, and vocabulary comprehension.

At the same time, the study revealed notable challenges. Participants highlighted barriers such as unstable internet connections, hardware limitations, and varying levels of digital readiness, which could restrict the feasibility and inclusivity of metaverse-based learning. These issues underscore that the adoption of metaverse technologies requires substantial infrastructural support, careful pedagogical integration, and attention to equity of access.

Given the small qualitative sample, the conclusions of this study should be interpreted with caution. The findings provide initial insights rather than generalizable evidence. Future

research should employ larger and more diverse samples, longitudinal designs, and mixed-methods approaches to capture the long-term effects and complexities of integrating metaverse technologies in language education.

For educators and institutions, the study highlights both the opportunities and responsibilities in leveraging emerging technologies. Efforts should focus on ensuring accessibility, supporting teacher professional development, and designing inclusive learning environments that maximize the benefits of virtual immersion while minimizing technological barriers. With these considerations, the metaverse has the potential to complement traditional pedagogies and enrich English language learning for diverse student populations.

### DECLARATION OF GENERATIVE AI

During the preparation of this manuscript, the authors used AI-assisted tools, including ChatGPT, Grammarly, and QuillBot, to support language editing and improve grammatical accuracy. The authors carefully reviewed and edited the output generated by these tools and take full responsibility for the content of the manuscript

### 6. REFERENCES

- Al-kfairy, M., Alomari, A., Al-Bashayreh, M., Alfandi, O., & Tubishat, M. (2024). Unveiling the Metaverse: A survey of user perceptions and the impact of usability, social influence and interoperability. *Heliyon*, 10(10), e31413. <https://doi.org/10.1016/j.heliyon.2024.e31413>
- Aydın, S. (2022). The Metaverse in Foreign Language Learning: A Theoretical Framework. *Innovational Research in ELT*, 3(2), 12–19. <https://doi.org/10.29329/irelt.2022.505.2>
- Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77–101. <https://doi.org/10.1191/1478088706qp063oa>
- Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly: Management Information Systems*, 13(3), 319–339. <https://doi.org/10.2307/249008>
- Dwi Hatmanto, E., Widi Pratolo, B., Intansari, M., Muhammadiyah Yogyakarta, U., Brawijaya, J., Kasihan, K., Bantul, K., & Istimewa Yogyakarta, D. (2023). Metaverse magic: Unveiling the pedagogical potential and transformative effects on intercultural communication in English language teaching. *English Language Teaching Educational Journal*, 6(1), 14–31. <https://doi.org/10.12928/eltej.v6i1.8627><http://journal2.uad.ac.id/index.php/eltej/index>
- Fatimah, A. S., & Santiana, S. (2017). Teaching in 21st century: Students-teachers' perceptions of technology use in the classroom. *Script Journal: Journal of Linguistic and English Teaching*, 2(2), 125.
- Gualano, R. J., & Campbell, S. W. (2024). Classrooms in the metaverse: educational applications and levels of learner interaction in virtual reality. *Communication Education*, 73(2), 212–225. <https://doi.org/10.1080/03634523.2024.2312873>
- Guest, G., Namey, E., Chen, M., 2020. A simple method to assess and report thematic saturation in qualitative research. *PLoS One* 15 (5), e0232076. <https://doi.org/10.1371/journal.pone.0232076>

- Hennink, M., Kaiser, B.N., 2022. Sample sizes for saturation in qualitative research: A systematic review of empirical tests. *Social Science & Medicine* 292, 114523. <https://doi.org/10.1016/j.socscimed.2021.114523>
- Hennig-Thurau, T., Aliman, D. N., Herting, A. M., Cziehso, G. P., Linder, M., & Kübler, R. V. (2023). Social interactions in the metaverse: Framework, initial evidence, and research roadmap. *Journal of the Academy of Marketing Science*, 51(4), 889–913. <https://doi.org/10.1007/s11747-022-00908-0>
- İbili, E., Ölmez, M., İbili, A. B., Bilal, F., Cihan, A., & Okumuş, N. (2024). Assessing the effectiveness and student perceptions of synchronous online flipped learning supported by a metaverse-based platform in medical English education: A mixed-methods study. *Education and Information Technologies*. <https://doi.org/10.1007/s10639-024-12542-0>
- Jiao, Y., Dewitt, D., & Razak, R. B. A. (2024). Exploring the Potential of Metaverse-Based Platforms for Enhancing English as a Foreign Language (EFL) Learning: A Comprehensive Systematic Review. *International Journal of Information and Education Technology*, 14(2), 231–239. <https://doi.org/10.18178/ijiet.2024.14.2.2044>
- Khaira, M., Lesmana, D. C., Agustina, P., & Saputra, D. (2024). Utilization of the metaverse in the context of interactive learning. *Hipkin Journal of Educational Research*, 1(2), 151–162.
- Kim, H.-S. (2023). Impact of Metaverse-Based Speaking Activities for Second Language Learning. *STEM Journal*, 24(4), 57–72. <https://doi.org/10.16875/stem.2023.24.4.57>
- Li, M., & Yu, Z. (2023). A systematic review on the metaverse-based blended English learning. *Frontiers in Psychology*, 13. <https://doi.org/10.3389/fpsyg.2022.1087508>
- Lyu, Z. (2023). State-of-the-Art Human-Computer-Interaction in Metaverse. *International Journal of Human-Computer Interaction*, 0(0), 1–19. <https://doi.org/10.1080/10447318.2023.2248833>
- Nur, D. R., Widodo, P., & Putro, N. H. P. S. (2023). Digital Natives Generation Enjoyment Using Online Resources as Virtual Learning Environment in Learning English Speaking. *International Journal of Language Education*, 7(4), 602-614.
- Pujasari, R. S., Fatimah, A. S., Sri, M., & Sulastri, F. (2024). Potential Benefits of Metaverse Concept Implementation in English for Tourism Course: A Case Study in Indonesian Higher Education Contexts. *International Journal of Language Education*, 8(3), 520-532.
- Puncreobutr, V., Dhamacharoen, A., & Tapaneeyakorn, W. (2022). Factors Affecting The Readiness Of Thai Universities To Organize Learning Activities In The Metaverse Era. *Webology*, Volume 19(No. 2), 9285–9296. <http://www.webology.org/abstract.php?id=2702>
- Reisoğlu, I., Topu, B., Yılmaz, R., Karakuş Yılmaz, T., & Göktaş, Y. (2017). 3D virtual learning environments in education: a meta-review. *Asia Pacific Education Review*, 18(1), 81–100. <https://doi.org/10.1007/s12564-016-9467-0>
- Santiana, S., Silvani, D., & Ruslan, R. (2021). Optimizing LMS CANVAS for interactive online learning perceived by the students. *Journal of English Education and Teaching*, 5(4), 529-543.
- Santiana, S., Margana, M., Putro, N. H. P. S., & Widodo, P. (2024). Students' Attitudes toward the Use of CANVAS in the EFL Virtual Learning Environment. *International Journal of Language Education*, 8(2), 267-290.
- Tlili, A., Huang, R., Shehata, B., Liu, D., Zhao, J., Metwally, A. H. S., Wang, H., Denden, M., Bozkurt, A., Lee, L. H., Beyoglu, D., Altinay, F., Sharma, R. C., Altinay, Z., Li, Z., Liu, J., Ahmad, F., Hu, Y., Salha, S., ... Burgos, D. (2022). Is Metaverse in education a blessing or a curse: a combined content and bibliometric analysis. *Smart Learning Environments*, 9(1). <https://doi.org/10.1186/s40561-022-00205-x>

- Wang, M., Wang, H., & Shi, Y. (2022). The role of English as a foreign language learners' grit and foreign language anxiety in their willingness to communicate: Theoretical perspectives. *Frontiers in Psychology*, 13(September), 1–11. <https://doi.org/10.3389/fpsyg.2022.1002562>
- Yin, R. K. (2018). *Case Study Research and Applications Design and Methods (6th ed.)*. Thousand Oaks, CA Sage.
- Zhang, X., Chen, Y., Hu, L., & Wang, Y. (2022). The metaverse in education: Definition, framework, features, potential applications, challenges, and future research topics. *Frontiers in Psychology*, 13(October), 1–18. <https://doi.org/10.3389/fpsyg.2022.1016300>