

Improving German AI *Hören* and *Schreiben* Skills through Metaverse-Based Interactive Learning with AI Integration in Roblox

RISNOVITA SARI¹, RINA EVIANTY¹, RENY SYAFRIDA², HERLINA JASA PUTRI¹,
RIA FUJI DESTIARA¹, MUHAMMAD AKBAR GULVARA¹, ARIEF BUDIONO^{3,*},
TURDIALIEV MUKHAMMAD ALI POLATJON OGLI⁴

¹Department of German Literature,
Universitas Negeri Medan,
Willem Iskandar Pasar V Street, Medan Estate, Percut Sei Tuan District, Medan, North Sumatra,
INDONESIA

²Universitas Dharma Persada,
Jalan Taman Malaka Selatan No.8, Pondok Kelapa,
Kecamatan Duren Sawit, East Jakarta City,
Special Capital of Jakarta 13450,
INDONESIA

³Department of Law,
Universitas Muhammadiyah Surakarta,
A. Yani Street, Pabelan, Kartasura, Sukoharjo Regency, Central Java,
INDONESIA

⁴Department of Private International Law,
Tashkent State University of Law,
Amir Temur Avenue 13, 100000, Tashkent,
UZBEKISTAN

**Corresponding Author*

Abstract: - This study reports the development and implementation of a Metaverse-based learning medium using the Roblox platform to improve German language skills at the A1 level, specifically in the areas of *Hören* (listening) and *Schreiben* (writing). A descriptive-developmental research design was used, involving 30 undergraduate students taking an introductory German course at a public university in Indonesia. The learning environment was designed through Roblox Studio to replicate an interactive virtual classroom equipped with immersive scenarios and game-based features to support language practice. Data were collected through a Likert-scale questionnaire, open-ended questions, and classroom observations. Quantitative results indicated that most students highly rated the design, ease of use, and its contribution to improving listening and writing skills. Qualitative findings further revealed that students felt more motivated, engaged, and connected through the immersive features and game-style environment, despite occasional technical difficulties and distractions. The study concluded that the Metaverse-based learning medium on Roblox offers an innovative and effective alternative to conventional online learning by providing contextualized practice opportunities, enhancing social presence, and strengthening student engagement in foreign language learning.

Key-Words: - Metaverse, Roblox, German language learning, Listening (*Hören*), Writing (*Schreiben*), virtual classroom.

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1 Introduction

Technology integration in higher education has become a critical need to address 21st-century

challenges. Technology not only enriches the learning experience but also increases student engagement, improves learning outcomes, and

prepares students to face global challenges with greater adaptability. One rapidly developing innovation is the use of Metaverse in education, which enables the creation of immersive learning spaces based on interactive Virtual Reality (VR), Augmented Reality (AR), and Extended Reality (XR) technologies that support contextual learning, [1], [2].

The application of the Metaverse in education opens new opportunities for the development of collaborative, flexible, and immersive learning media. In this context, platforms like Roblox are gaining traction due to their ability to provide interactive and participatory simulation-based learning experiences. Roblox's advantages include an easily accessible Software Development Kit, user-friendly visual programming tools, and a growing educational community, making it a potential platform for building immersive learning environments, [3].

However, foreign language learning especially German still faces significant challenges in online contexts. Many students struggle to master basic skills such as listening and writing, which are essential foundations for initial communication in a foreign language, [4], [5]. Lack of active engagement in online learning often hinders the achievement of learning goals and lowers student motivation, [6], [7].

Numerous studies have shown that interactive digital media technologies—including VR, AR, and platforms like Roblox—are effective in improving students' language skills and engagement, [8], [9]. Metaverse-based learning enables direct interaction in contexts that mimic real-world situations, thereby increasing engagement, understanding, and more effective knowledge transfer, [10], [11]. Thus, Roblox-based learning media has great potential as an innovative solution to overcome the limitations of online German language learning.

Despite the vast potential of Metaverse in education, there is still a research gap in the context of German language learning. A systematic review by [12], showed that of the more than 100 articles reviewed, only a small portion discussed the use of Metaverse in teaching languages other than English. This confirms that the integration of Metaverse and platforms such as Roblox in the development of German language learning media especially for Hören and Schreiben skills is still limited and requires further exploration, [13].

As for the effectiveness of the Metaverse learning environment, it can be seen at German language education that adopts a student-centered learning approach that emphasizes collaboration,

active learning, and context-based learning, [1], [10], [14]. In this context, the Metaverse provides an immersive environment that encourages teamwork, problem solving, as well as language integration through narrative exploration and role-playing, [14], [15], [16]. This environment aligns with social constructivism theory, [17], which provides opportunities to develop 21st century competencies such as collaboration, creativity, communication, and critical thinking.

Metaverse places learners at the center of the educational process by enabling active engagement, reflection, and application of knowledge in realistic contexts, [18]. Its interactive and immersive nature allows students not only to understand theoretical concepts, but also to experience authentic problem-solving situations that resemble real-world environments [1], [19]. In this context, teachers act as facilitators who guide students to build knowledge through collaborative and reflective activities, [20].

In addition, the integration of VR/AR technology strengthens the implementation of game-based active learning in Metaverse, while addressing the need to motivate and maintain student interest. A realistic learning environment has been proven to increase the transfer of knowledge and skills while encouraging learning motivation, [10], [11].

According to the situated learning approach, knowledge is understood and applied in the context where the knowledge is obtained, [21], so that learning is not just memorizing facts, but involves active participation in everyday life, [18]. This concept is increasingly relevant with the presence of the Metaverse, which is able to provide immersive and realistic virtual learning spaces that simulate real-world situations through interactive simulations and digital practical experiences, [22]. With the support of VR, AR, and avatars, students can engage in active and contextual learning that is integrated with modern digital routines and culture, thereby increasing their motivation and involvement in the learning process, [10].

Virtual learning through Metaverse can significantly increase student satisfaction and retention. The educational simulations available in it also have a positive impact on learning outcomes. Additionally, the Metaverse allows students to access experiences that could be explored independently, but are difficult, expensive, dangerous, or impossible in the real world, [9].

Because training for children takes place in a realistic context in this environment, [23], it supports the transfer of knowledge and skills

through increased situational learning and spatial understanding, and allows participants to understand the environment without having to be physically present, [24].

Furthermore, Metaverse has also proven effective as a learning tool that enriches the learning experience, especially for young students. Numerous studies report that Metaverse has a positive impact on learning outcomes and increases satisfaction, engagement, and comfort during the interactive learning process, which ultimately results in a better learning experience, [25], [26], [27], [28]. Other studies confirm that Metaverse can produce superior learning outcomes compared to conventional methods because it provides an interesting, flexible and participatory learning environment. In addition, Metaverse has the potential to expand and enrich educational content, reduce costs, and improve the quality and efficiency of education, [29]. Compared to traditional methods, Metaverse has proven to be more effective in providing immersive learning experiences and supporting self-directed learning, [27], [30]. Innovative technology such as Metaverse also improves the quality of interaction between teachers and students throughout the learning process.

Furthermore, research has conducted studies on technology-based foreign language learning. Technology-based foreign language learning is developing rapidly, especially with the emergence of tools that enable learning experiences to take place in more authentic and meaningful contexts. Modern learning technology allows students to acquire languages through direct experiences outside the classroom, such as on campuses, museums, or other public spaces, where languages are learned in real situations that are socially and culturally relevant, [31], [32]. By combining the physical and digital worlds, this technology allows students to interact in contexts that resemble real-life situations, thereby supporting contextual learning.

Many studies show that the integration of technology in foreign language learning has a positive impact on language acquisition. Liu and Chu, [5], found that QR code and Augmented Reality (AR) based applications can increase students' motivation and listening skills. Similar results were reported by Cheng et al., [4], that students who use interactive technology in a familiar environment show increased confidence in speaking and presentation skills. In terms of writing, learning technology has been proven to improve the quality of written text, both in terms of sentence structure and depth of content, [33].

For vocabulary learning, technology provides important support through delivering material at the right time, place and context. Chen and Li, [31], show that context-based content delivery significantly improves vocabulary acquisition. Location-based learning applications such as Mentira and LOCH have also proven effective in improving students' communication skills through direct involvement in authentic communities and activities, [34], [35]. Apart from linguistic skills, technology also supports the development of pragmatic and cultural aspects in foreign language learning. Elements such as cultural expressions, social norms, and communication ethics which are often difficult to teach theoretically can be learned naturally through simulations or interactions in digital environments that resemble real situations, [36], [37]. This shows that the use of technology not only increases linguistic competence but also socio cultural competence, [38].

Overall, the research findings show that the integration of technology in foreign language learning can significantly improve motivation, engagement, and learning outcomes. Technology encourages a more active, collaborative and meaningful learning experience, and makes the learning process closer to real life, [39], [40], [41]. Therefore, the use of modern learning technology is very relevant to support Hören (listening) and Schreiben (writing) skills in learning German.

Regarding the effectiveness of technology in increasing learning motivation, [42], it can be seen in the context of modern education, technology is proven to play an important role in increasing students' learning motivation, [43]. Various recent studies show that the use of digital media such as learning applications, social media, and online platforms can significantly increase student engagement and intrinsic motivation. For example, Honarзад and Rassaei, [8], found that technology-based learning tasks had a positive influence on students' self-efficacy and learning motivation. [44] also emphasized that students studying in an online context show motivational characteristics such as goal orientation, self-confidence, and persistence in completing assignments. [45]

Taking notes that educational technology can increase social interaction between students and foster motivation towards learning material. In addition, [46], revealed that technology broadens students' perspectives on language learning and creates a more positive learning context. Similar findings were reported in [47], which shows a positive relationship between teachers' beliefs in digital technology integration and increased student

motivation and engagement. [48] stated that technology-based learning not only accelerates language competence, but also produces positive emotions that encourage learning motivation. [49] and [50] also emphasized that factors such as the attractiveness of learning materials, goal-oriented application design, and game-based learning have a major influence on students' intrinsic motivation and learning engagement.

Based on this background, the research questions and objectives of this study are as follows: How can A1-level German language learning media be developed through Metaverse using the Roblox platform?, What is the impact of using Roblox-based learning media on improving students' Hören and Schreiben skills?, What are the challenges and limitations that arise in implementing Roblox-based learning media in German language learning at the A1 level?

2 Methods

This study uses a descriptive approach with a developmental research method, [51], which focuses on the process of developing Metaverse-based German A1 learning media using the Roblox platform, and evaluating students' perceptions of its use. This study does not examine differences in pretest and post-test scores, but rather examines the quality of the developed media and user responses to its effectiveness in supporting *Hören* (listening) and *Schreiben* (writing) skills.

The development and implementation of learning media was conducted at a state university in Indonesia over a four-week period during the even semester of the 2025 academic year. The media was designed to accommodate German A1 learning in an immersive and interactive 3D virtual environment. Roblox was chosen because it provides a flexible Software Development Kit, supports the design of situational learning environments, and enables user collaboration in a shared virtual world.

Participants consisted of 30 undergraduate students taking an introductory German course. Purposive sampling was used to select participants based on their willingness to participate in the entire media trial process and complete the evaluation questionnaire. All participants had relatively similar initial proficiency levels due to having previously completed an introductory foreign language course.

This study utilized Roblox as a Metaverse platform to build a virtual learning environment. The environment was designed to resemble an interactive classroom where students participate through avatars, communicate with instructors, and

engage in German A1 learning activities. Screenshots of the virtual environment are presented in the Results section to illustrate the layout, activities, and forms of interaction that occurred during the learning process.

Learning sessions are conducted over four weeks, with a consistent classroom setup for each session. Key elements such as chairs, whiteboards, and discussion areas are maintained to create a consistent learning environment. Meanwhile, learning materials are updated weekly based on topics, ensuring students receive variety even while in the same classroom.

The visual assets in this study were developed using Roblox Studio, supported by a collection of free 3D assets. Objects such as chairs, whiteboards, and classroom decorations were arranged to create an engaging and realistic learning environment. Furthermore, interactive features like leaderboard and specific buttons were programmed to support activities like answering questions, writing, and recording scores, [52].

Students are represented through customizable experiences, [53], allowing them to express their individual identities. This feature fosters a sense of community while enriching the personalized learning experience. Instructors also use custom avatars to lead classes and maintain active engagement.

The virtual environment includes the main learning area, classrooms, a cafeteria, a hall, a lecturer's lounge, and a discussion corridor, as shown in Figure 1 (a–f). This design was created to replicate real-world settings, making learning more contextual. With this design, Metaverse-based learning has proven to be able to provide interactive experiences, increase social presence, and strengthen student engagement compared to conventional online learning.



(a)



(b)



(c)



(d)



(e)



(f)

Fig. 1: Illustration of a virtual learning space in the Roblox-based Metaverse (a-f)

Source: created by the authors

According to Figure 1, the media was tested in four 60-minute learning sessions. Each session included scenario-based activities integrating audio conversations (for the *Hören*) and short writing assignments (for the *Schreiben*). Participants interacted with the virtual environment via computer, completed learning tasks, and participated in discussions using the chat feature. The facilitator provided technical instructions at the beginning of the session and guided reflection at the end, [54].

The research data were collected through a two-part student perception evaluation questionnaire, [55]. The first part contained closed-ended questions with a five-point Likert scale to assess aspects such as media design, ease of use, content relevance, and its contribution to improving *Hören* and *Schreiben* skills. The second part contained open-ended questions aimed to explore students' learning experiences, impressions of the media, and challenges faced during the learning process. In addition, the researcher conducted participant observation throughout the session to obtain additional data that enriched the understanding of students' perceptions of the developed learning media, [56].

Quantitative data from the questionnaires were analyzed descriptively by calculating average scores and percentages to illustrate the general trends in responses, [57]. Qualitative data from open-ended questions and observation notes were analyzed by categorizing responses and interpreting patterns relevant to the learning context.

3 Results and Discussion

The majority of students found the Metaverse-based learning environment engaging and beneficial in improving their *Hören* and *Schreiben* skills in German. As shown in the figure, the majority of students rated the media's contribution to their improvement as 4 (good) or 5 (very good). They appreciated the interactive and immersive nature of the media, which provided a more engaging and stimulating learning experience than conventional teaching methods.

According to Figure 2, students report that the hands-on approach offered through the Metaverse-based learning environment provides a more immersive learning experience compared to traditional classroom instruction. Label for the Respondent response Metaverse-based learning is categorized as 1 (very bad), 2 (bad), 3 (average), 4 (good) and 5 (very good).

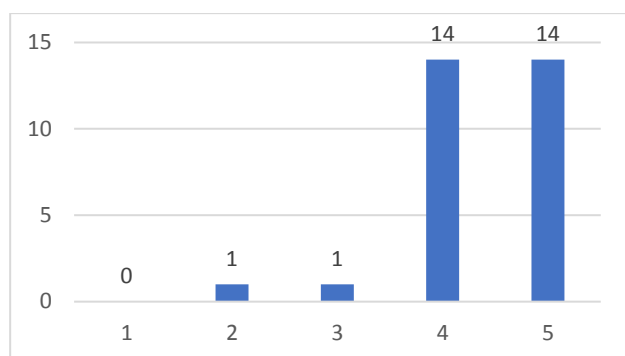


Fig. 2: Respondent response Metaverse-based learning

Source: created by the authors

The platform's visual and interactive features not only help them grasp concepts more clearly but also facilitate more effective information retention. Hands-on interaction with virtual objects and simulations allows students to build a stronger conceptual understanding while contextualizing the connection between theory and practice. This approach also encourages active engagement, increases motivation to learn, and creates a more meaningful and real-world learning experience.

Table 1 (Appendix) explain about Items, Frequencies, Descriptive Statistics, Reliability, and Coding Procedure while feedback was generally positive, students identified several areas for improvement, such as bug fixes, improved touch responsiveness, expanded content and activity variety, clarity of instructions, and integration of real-world elements with additional features like circuit design. Artificial intelligence (AI) played a crucial role in addressing this feedback, particularly in identifying technical issues and supporting the development of new features. For example, when students reported that dialog text was too small and disappeared from the screen too quickly, the AI generated code to increase the font size, adjust the display duration, and reposition the text for better readability, [52]. This code validated by the authors manually during the research process.

Additionally, responding to student suggestions for increasing the variety of content and activities such as adding new learning scenarios, interactive language games, and simulation-based challenges AI is leveraged to help generate appropriate scripts and development ideas. Through this iterative development process, the Metaverse-based learning environment can be continuously expanded, refined, and adapted to remain engaging, relevant, and supportive of German language learning goals.

In this study, Metaverse-based German A1 learning was compared with conventional learning

experiences through an evaluation of students' perceptions and learning experiences. The study was conducted over four weeks with 30 students taking an introductory German course. The results showed that Metaverse-based learning received positive assessments in terms of media design, ease of use, material relevance, and its contribution to the development of listening and writing skills.

Students also reported higher levels of engagement and more enjoyable learning experiences compared to conventional methods. Interactive virtual environments were found to be effective in enhancing comprehension through contextual simulations that mimic real-world situations. These findings confirm that Metaverse environments are effective in supporting foreign language learning, particularly in *Hören* and *Schreiben* skills. Consistent with previous research, the study results indicate that Metaverse-based methods are more effective in improving learning outcomes than conventional approaches, [58], [59]. Metaverse learning offers advantages such as supporting lifelong learning, [60], [61], facilitating the learning process, [62], [63], helping to understand abstract concepts, [64], encouraging in-depth learning, [1], and providing rich 3D visualizations, [65]. This learner-centered learning model also increases active engagement during the learning process, [66], [67]. Students also stated that Metaverse-based learning is more enjoyable and increases learning interest, which positively impacts motivation and participation, [62], [68].

From a language skills perspective, Metaverse-based media significantly contributed to improving listening (*Hören*) and writing (*Schreiben*) skills, as well as enriching vocabulary relevant to everyday communication. Authors employed several Major AI which is Chatgpt, Claude.ai, Gemini, Deepseek.

Qualitative data from student reflections indicated that the flexibility of the virtual environment allowed them to participate in all process, learn collaboratively, and engage in repeated practice, making the learning process more personalized and adaptive. Early access to materials before the main session also helped students connect the content more meaningfully to class activities, while also practicing higher-order thinking skills such as analysis, synthesis, and evaluation, [69]. These findings confirm that Metaverse-based learning not only replicates the real-life classroom experience but also expands learning opportunities beyond the boundaries of time and space, making the learning process more active, contextual, and sustainable. In contrast, conventional learning tends to be limited by low interaction, minimal

opportunities for collaborative practice, and a more passive approach, [70], [71], [72].

Overall, Metaverse-based learning proved more effective than conventional methods in supporting foreign language acquisition, particularly *Hören* and *Schreiben* skills. However, this study also identified several limitations, such as the need for additional preparation time, the need for technical support for students unfamiliar with the platform, and potential distractions from interactive features not directly related to learning objectives. Nevertheless, the research findings indicate that Metaverse is an effective and user-friendly medium for creating engaging and meaningful learning experiences for students.

4 Conclusion

The findings of this study confirm that Metaverse-based learning media through the Roblox platform can improve German A1 skills, particularly *Hören* (listening) and *Schreiben* (writing). The immersive and interactive virtual environment has proven more effective than conventional online learning, as it creates a game-like atmosphere that encourages active engagement, increases motivation, and provides a more contextual learning experience. Quantitative results indicate that students gave positive assessments of the design, ease of use, and its contribution to language skill development. Qualitative findings support these results by indicating that students felt more motivated, more connected, and more flexible in the learning process.

However, this study also identified several limitations, such as technical challenges related to internet quality, distractions from avatars or non-essential features, and time constraints in content development. This suggests the need for more thorough instructional planning and adequate technical support to optimize the media's effectiveness. The practical implications of this study are that Roblox can be an innovative alternative for foreign language learning through the integration of collaborative elements, 3D visualization, and game-based learning. Future research is recommended to explore more varied learning designs, integrate AI features for more personalized content, and involve a larger sample to increase the generalizability of the findings. Thus, Metaverse-based learning media can continue to be developed as an inclusive, adaptive, and relevant tool for higher education in the digital era.

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Declaration of Generative AI and AI-assisted Technologies in the Writing Process

During the preparation of this work, the author(s) utilized artificial intelligence (AI) technologies solely for the purpose of linguistic refinement and grammatical correction. Following the application of these tools, the author(s) comprehensively reviewed, verified, and edited the resulting text. The author(s) maintain full accountability and responsibility for the accuracy, integrity, and final content of the publication.

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Contribution of Individual Authors to the Creation of a Scientific Article (Ghostwriting Policy)

Sari: Conceived the research and provided materials and data for the research.

Evianty: Provided materials and data for the research as well as designed the methods.

Syafrida and Putri: Selected research data as well as analyzed and interpreted the data.

Destiara and Gulvara: Analyzed the data and provided a description of the results.

Budiono: Wrote the introduction and arranged the script according to the instructions.

Ogli: Wrote the conclusion and finalized the methods

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Conflict of Interest

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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APPENDIX

Table 1. Student Responses: Items, Frequencies, Descriptive Statistics, Reliability, and Coding Procedure

Questionnaire Item	Sample Responses	Response Frequencies/ Emergent Themes	Descriptive Statistics	Coding Procedure (Qualitative)	Reliability Evidence
How would you describe the experience of learning German in a Metaverse environment compared to learning in a conventional classroom?	The Metaverse environment makes learning more interesting and less monotonous than conventional methods. This experience motivated me to study German outside of class hours. The visual design is very engaging; we can connect the materials more effectively, and learning feels more effective than in a traditional classroom.	Theme: Increased interest / reduced monotony (illustrative excerpt provided) Theme: Extended motivation beyond class hours (illustrative excerpt provided) Theme: Improved material connection via visual design (illustrative excerpt provided) <i>Note: exact frequency counts across all 30 participants are not reported in the source article; only representative excerpts are presented.</i>	Not reported at the item level for the open-ended questions. Overall study N = 30 undergraduate students. Quantitative (Likert-scale) items on media design, ease of use, and contribution to Hören/Schreiben skills were summarized descriptively (means/percentages) and presented visually in Figure 2; most students rated these aspects 4 (good) or 5 (very good). No corresponding numerical descriptive statistics (e.g., mean, SD, % per theme) were computed or reported for the open-ended items in the source article.	Per the Methods section: "Qualitative data from open-ended questions and observation notes were analyzed by categorizing responses and interpreting patterns relevant to the learning context." This indicates a thematic/categorical grouping of responses. The article does not specify: number of coders, a formal codebook, whether coding was independent/blind, or software used for analysis.	Not reported. No inter-rater reliability coefficient (e.g., Cohen's Kappa, percentage agreement) is provided for the qualitative coding process. No internal consistency measure (e.g., Cronbach's alpha) for the Likert-scale instrument is reported either.
Has Metaverse-based learning made you more motivated to learn German? Explain why.	Because the atmosphere felt like playing a game, I became more enthusiastic about participating in the learning. I want to learn more because the material is presented in a unique and interactive way. This experience made me more motivated to learn German outside of class hours.	Theme: Game-like atmosphere increases enthusiasm (illustrative excerpt provided) Theme: Unique/interactive material presentation (illustrative excerpt provided) Theme: Motivation extends beyond class hours (illustrative excerpt provided) <i>Note: exact frequency counts across all 30 participants are not reported in the source article.</i>			
Were there any disruptions or obstacles during Metaverse-based learning? Please explain.	Slow internet connection interferes with the learning process. The noise from other participants who forgot to turn off their microphones disturbed my concentration. Yes, because I was busy customizing my avatar and exploring other features.	Theme: Technical/connectivity issues (illustrative excerpt provided) Theme: Environmental/peer-generated distraction (illustrative excerpt provided) Theme: Self-generated distraction (avatar/feature exploration) (illustrative excerpt provided) <i>Note: exact frequency counts across all 30 participants are not reported in the source article.</i>			
What are your suggestions for improving the quality of	I wish there was more learning content available. Adding variety to	Theme: Request for more learning content (illustrative excerpt provided)			

Questionnaire Item	Sample Responses	Response Frequencies/ Emergent Themes	Descriptive Statistics	Coding Procedure (Qualitative)	Reliability Evidence
Metaverse-based learning experiences?	activities to make learning more interesting. It would be better if each part in the virtual environment was divided into easy-to-understand areas.	Theme: Request for greater activity variety (illustrative excerpt provided) Theme: Request for clearer spatial/structural organization (illustrative excerpt provided) <i>Note: exact frequency counts across all 30 participants are not reported in the source article.</i>			

Note. Data were drawn from the open-ended section of a two-part student perception questionnaire administered to N = 30 undergraduate students following a four-week Metaverse-based (Roblox) German A1 learning intervention. Where the source article did not report item-level numerical statistics or formal reliability coefficients, this is stated explicitly rather than estimated.

Source: Created by Authors