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Technology integration in learning Mandarin Chinese as a foreign language in Malaysia and Germany

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ABSTRACT

The use of technology in foreign language learning has gained significant attention, particularly in countries like Malaysia and Germany, where Chinese is taught as a foreign language. This paper compares how technology is integrated into Chinese language learning in these two countries, highlighting its potential to improve learning outcomes. We explore key factors such as student motivation, cultural influences, and the challenges faced by learners, providing empirical evidence on the similarities, differences, and impacts of the technologies used. Additionally, we emphasize the importance of teacher-related factors in language instruction and offer pedagogical recommendations for educators and stakeholders. Finally, we acknowledge the study's limitations and suggest areas for future research, particularly focusing on teacher adaptability in language education.

1. Introduction

China's huge economic growth in recent years has made it a major player in the world economy. Today, with over 1 billion native speakers, Mandarin Chinese is the most widely spoken language globally, excluding the millions of people who speak Mandarin as a second or foreign language (Cheong, 2022). It happened in Malaysia, and the number of non-native students in Malaysia's Chinese schools has increased from 11.84% in 2010 to 19.75% in 2020 (Heng et al., 2021). In Germany, it was found that UK international students have taken Chinese A-level assessments more than German, surpassing German for the first time in 2018 (Osborne et al., 2019). Mandarin Chinese is becoming more popular as interest in other foreign languages declines. The benefits of acquiring it include job advancement, cultural interest, travel and tourism, academic research and exchange, personal growth, and intellectual stimulation. These encourage non-native learners to pursue their goals and gain practical, cultural, and personal benefits, although Mandarin Chinese is difficult to master. All foreign language learners, including those in Malaysia and Germany, confront several obstacles, such as the language's difficulty and the lack of speaking practice opportunities. Luckily, the incorporation of digital resources, such as online dictionaries, language-learning applications, etc., is available for students to improve their learning experiences. Also, online learning can retain students' motivation and enhance their language skills. These highlight that motivation, technology, and cultural organizations are important in Mandarin language learning and the need to overcome the challenges the students face in learning Mandarin as a foreign language.

Malaysia and Germany differ concerning their educational systems and cultures. Yusof et al. (2022) believed the Malaysian educational system fosters holistic development, religious education, and national unity. Academic performance, critical thinking, and social responsibility are emphasized in German education. In a similar study, Ur Rahman et al. (2020) found that Malaysians value collectivism, interpersonal relationships, and authority, whereas Germans favor individualism, rationalism, and direct communication. However, they do not explain how these variations impact technology integration in language teaching. It is uncertain how the Malaysian education system's emphasis on holistic development, religious education, and national unity and the German education system's emphasis on

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academic excellence, critical thinking, and social responsibility may impact language instruction and technology integration. Malaysian and German cultural differences have no specific bearing on language instruction technology. Therefore, additional research is required to investigate how cultural and educational variations influence the usage and effectiveness of technology in Malaysian and German language instruction.

Additionally, many schools and language centers in Malaysia and Germany offer Mandarin language classes to meet the growing demand (Chan et al., 2022). With this rising demand, examining how technology can improve language learning outcomes, address language learner challenges, and increase access to language education is crucial. This study can help develop effective and relevant technology integration strategies in other contexts. Moreover, the frequency of technology use differs among teachers. There is a need for further research to explore the similarities and differences in technological integration in language education across various regions and settings. It highlights the importance of investigating the impact of technology on specific language skills and determining the most effective methods for integrating technology to enhance language learning outcomes (Sijabat et al., 2022). Ultimately, addressing these research gaps can guide future studies and contribute to advancing technology integration in Mandarin language education.

So, comparing the technological innovation approach in the teaching and learning of Mandarin in Malaysia and Germany can provide insight into the differences and similarities in the implementation and effectiveness of technology integration in Mandarin language education in these two countries. These courses were selected for comparison because Malaysia and Germany have distinct educational systems and cultural backgrounds, making the comparison of their approaches to technology integration in language education an interesting research area. Also, both countries have significant populations of Mandarin language learners and a growing demand for Mandarin language education, making it relevant to study their approach to technology integration in this field. So, this study aims to understand how technology is currently being used in Mandarin Chinese language teaching and learning in Malaysia and Germany and to provide insights for language educators and policymakers on the effectiveness of technology integration in these different cultural and linguistic contexts.

2. Literature review

2.1. Technology-enhanced language learning in Malaysia

The application of technology in L2 Chinese teaching and learning is a growing research area (Lyu and Qi, 2020). Technology-enhanced language learning technology is a tool to assist teachers of foreign languages in facilitating and mediating language learning to boost learners' language acquisition (Simaremare et al., 2023) and competency through various digital tools and resources (Chang and Hung, 2019; Ismail et al., 2022; Shahidan et al., 2022). It involves using computer-assisted language learning, software, mobile applications, social media, virtual and augmented reality, and other digital tools to help develop language learners' skills. It supports listening, speaking, reading, and writing skills and provides more opportunities for interactive and collaborative learning, which can improve student engagement and motivation. Also, technology-enhanced language learning is described as using internet platforms and pertinent media to enhance the teaching of Chinese as a foreign language in Jiang's study (Wang et al., 2021). According to Luo (2022), technology-enhanced language learning is a teaching approach that blends conventional and contemporary teaching strategies, utilizing cutting-edge instructional technologies to support language learning. The most discussed concept Is Mobile-Assisted Language Learning (MALL). MALL was initially introduced in 1993 and evolved into a sub-subject of research within the larger field of mobile learning. It has motivated educators and students to use "anytime" and "anywhere" technology, which are fundamental principles in MALL (Luo, 2022). Also, Chua et al. (2021) mentioned that Mobile-Assisted Language Learning is a potential approach to address the difficulty of Mandarin. However, to make it a success, the existing factors that facilitated and hindered students' performance during the technology integration instruction were the most crucial.

In Malaysia, mobile learning technology is not widely used in Malaysia's education system, particularly in primary school, as Mahamad et al. (2016) mentioned. Some teachers still use a traditional teaching style in Mandarin classrooms (Jafri et al., 2020). In a technologically advanced setting, it appears that Chinese foreign language teachers do not actively teach Chinese with technology (Navarre, 2018). However, when technology is added to traditional ways of teaching a language in the classroom, it greatly affects how well the language is taught. In higher education, technology integration is more advanced. Most research on technology-enhanced language acquisition indicates that the effect is beneficial. For instance, Ling et al. (2019) examined the effects of mobile-assisted learning and traditional learning on Mandarin stroke writing among non-Chinese students at a Malaysian university. Positive effects were observed for both approaches, but the improvement rate differences were only 4.2%. Additional research is required to adequately accommodate individual demands in acquiring a new language. In the study of Deris and Shukor (2019), thirty-three students were selected to experiment with mobile apps for self-directed vocabulary learning. Positive acceptance and

desirable traits were observed; however, problems were also uncovered.

Studies also show effort in developing learning apps, which keeps on increasing. For instance, Ibrahim et al. (2017) created an educational mobile application for Android to assist students in learning and practicing Mandarin characters easily and interactively. The program 'Hanzi Swype Learning' comprises multiple tasks that teach students how to write Chinese characters rapidly and accurately. The application used the swipe application to achieve its target. In a separate study, Xin et al. (2020) constructed a Mandarin-learning application that can improve the proficiency of Mandarin novices. This research assists students in comprehending the accurate pronunciation and writing of Chinese characters. This application is useful for enhancing non-Mandarin speakers' Mandarin skills. Further research can be conducted by incorporating gaming components to make the application more desirable and engaging.

Nowadays, in the context of the information provided, technology-enhanced language learning refers to the use of virtual exchange programs to support learning Chinese as a foreign language. It has been found to promote cultural learning, improve language proficiency, increase learning motivation, and foster the creation of a language-learning community. For example, Luo (2022) proposed a virtual exchange program. The exchange involved a group of English majors who spoke Chinese at a Chinese university in Shanghai and two Chinese language classes (one at the elementary level and one at the intermediate level) from a tiny liberal arts institution in the United States. Analysis of four qualitative data sources—namely, the WeChat group cultural discussion transcripts, Skype conversations, reflection journals, and end-of-program interviews—led to the identification of four exchange benefits: promotion of cultural learning, improvement of Chinese language proficiency, improvement of learning motivation, and creation of a language learning community, a blend of conventional and contemporary teaching strategies, using cutting-edge instructional technologies in the process. Both groups fervently acknowledged the advantages of cultural learning and community building. There is still a lack of studies in the Malaysian context.

The cultural variable in learning Mandarin seems crucial in enhancing students' oral performance. Virtual reality (VR) can engage students in cognitive and emotional dimensions as well as improve their communication abilities. DeWitt et al. (2022) did a quasi-experimental study to see if using and designing VR settings connected to Chinese culture may increase students' Intercultural Communicative Competency (ICC). The data demonstrated a considerable rise in ICC measures following implementation, confirmed by student input via surveys and interviews. VR can improve ICC levels since it can be used to foster favorable views toward different cultures. ICC is crucial and required for cross-cultural cooperation and exchanges in a community to encourage tolerance and compassion for different cultures.

Lately, the emergence of Artificial intelligence (AI) has benefited the educational world, including learning languages. AI technology should be encouraged to be actively used in teaching Chinese as a foreign language and in developing all language-speaking skills in general (Chua et al., 2021). Traditionally, non-native students could only engage with the professors and rely completely on them for speaking practice. However, learners can employ AI technology to improve their interactive speaking skills as AI technology advances. The results revealed a fantastic positive response to using this AI technology. In sum, technology-enhanced language learning is a burgeoning research area that uses digital tools and resources to enhance language acquisition and competency. Technology integration in language learning has shown promise in various forms, including virtual reality, virtual exchange, and the application of Artificial Intelligence. These approaches have demonstrated a significant impact in promoting cultural learning, improving proficiency in the Chinese language, enhancing learning motivation, and fostering a community of language learners.

2.2. Technology-enhanced language learning in Germany

Germany has an extensive educational system since it was the first country to adopt compulsory education. Even if the digitalization of education significantly impacts economic and social processes, Germany's basic education is not as digitally advanced (Zhang, 2022). The outbreak of the COVID-19 epidemic has made digital education particularly significant, which is of enormous advantage to the development of basic education in Germany. However, there are numerous problems with the development of digital education in Germany's basic education stage, and the process of digitizing education varies from federation to federation. Germany is a world leader in developing and producing high-tech products in a wide range of fields, but its educational system is highly reliant on autonomy. Despite the COVID-19 pandemic, 97 percent of German schools and universities are public, and the federal government has agreed to invest 5 billion euros in secondary school digital technologies. However, due to cumbersome bureaucratic procedures and the requirement to develop good and aligned pedagogical principles for using technology (Kerres, 2020), most school districts have been unable to spend the money. In Germany, digital technology in education is a hotly disputed topic, with emotional debates centered on the utility of computers in teaching.

A German book authored by a physician has received much attention in the public discourse, and some parents have been protesting the installation of wireless LAN in schools, claiming that radio waves

are bad for teaching. There is an urgent need to explore smart education paths oriented towards real problem-solving to improve the development dilemma of digital education in Germany's basic education stage. According to Zhang (2022), German governments should avoid "bureaucracy" practices, keep abreast of people's needs, optimize the allocation of educational resources, and protect the rights and interests of school development. In order to achieve the healthy development of basic education, children's digital awareness and competence must be cultivated, and specialized digital teaching training must be provided for schoolteachers to enhance their digital literacy and build a solid foundation for developing digital education.

A quantitative research study by Küsel et al. (2020) found that German university students' readiness for using digital media and online learning in their tertiary education is less than that of US pupils. Overall, 72 students from the researchers' university in Germany and 176 students from multiple universities in the United States completed the Student Readiness for Online Learning (SROL) questionnaire. Regarding mobile app usage, Liu et al. (2014) examined the usefulness of mobile touch devices, such as mobile phones and tablet personal computers, in international students' Chinese learning. Thirty international students were invited to participate in the poll, including ten Germans, four Frenchmen, three Italians, two Iranians, two Russians, two Englishmen, two Americans, one Indonesian, one Pakistani, one Thai, one Swede, and one Kazakh. Users have a favorable attitude regarding using mobile Touch devices in Chinese Learning, and most respondents are willing to pay for it if the usability of mobile devices improves. It was claimed that beginning learners valued the motivation and organization of mobile Chinese learning tools. Advanced students are concerned with visual design, tactile performance, and cognitive processes. As it provides interactive learning tools, a mobile touch device is useful for learning Chinese. Still, the designer of the mobile program must make some effort to improve its usability. Regarding published articles on using mobile technologies in teaching and learning a foreign language. Hawamdeh and Soykan (2021) found from their review articles between 2014 and 2021 that only a few articles examined German and French (6%) from 100 articles. English was the most examined language in these articles (82%). It is reasonable given that English is the world's primary international language, particularly in the nations where the examined publications were done.

In a study in the earlier year of 2005, Ware et al. discussed the difficulties of using the Web for language instruction, the miscommunication between English and German language learners in Germany and the United States, and the objectives of foreign language teaching. These topics are typically unseen in cross-cultural contact. Teachers play a crucial role in assisting students in adopting an international perspective as they investigate the nature of language and communication across cultures. The situation of German higher education is different compared to that of basic students; learning languages with the assistance of technological advancements is at a higher level. Even before COVID, Schenker (2013) had examined a 12-week electronic contact between a German advanced English high school class and an American third-year German college class. Emails between tandem partners, blogs, videoconferences between the two classrooms, and class essays made up the interchange. The study looked at how taking part in the semester-long cross-cultural, cross-lingual interaction affected students' desire to learn more about the target culture. The findings demonstrated that pupils had a keen interest in learning about different cultures before and after the exchange. Students also agreed that knowing about culture is crucial to learning a foreign language. The virtual dialogue described here illustrates integrating language and culture training using a standards-based methodology.

During the pandemic, Chinese language teaching in German higher education shifted to remote teaching, which has presented new challenges. A survey of 39 BA students at a German university revealed that a blended teaching mode was the most supported, with preference varying between learner levels (Lin, 2022). This study confirms that Germany has not spent enough on its digital infrastructure, has poor Internet connections, and does not provide broadband access throughout the country. Ultimately, they state that Germany still has much to learn about digital learning. Technology integration into learning Mandarin Chinese as a foreign language has gained increasing attention recently. This topic requires a comparative analysis of the approaches and challenges in technology integration for Mandarin Chinese language learning in Malaysia and Germany. Both countries have different cultural backgrounds, educational systems, and technological infrastructures, which may affect the design and implementation of technology-enhanced language learning. A comprehensive examination of the use of technology in Mandarin Chinese language education in these two countries could provide insights into effective strategies for improving language proficiency, enhancing learners' motivation, and promoting intercultural communication.

2.3. The integration of technology

Table 1 compares technology integration in learning Mandarin Chinese as a foreign language in Malaysia and Germany. It highlights similarities and differences in the approaches and challenges associated with technology integration in the two countries. The following sections addressed the research questions using a literature review and document analysis. Table 1 also provides a comprehensive overview of the state of technology integration in Mandarin Chinese language education

in Malaysia and Germany, identifying similarities in the use of technology-enhanced language learning platforms, mobile apps, and social media, as well as differences in the level of digital infrastructure, access to resources, and cultural factors. Overall, the comparison provides insights into the status of technology integration in Mandarin Chinese language education in the two countries and identifies opportunities for future research and development in this area. Additionally, Fig. 1 summarizes a network of technology integration in learning Mandarin Chinese as a foreign language in Malaysia and Germany.

Table 1: Comparing the integration of technology in learning Mandarin Chinese as a foreign language in Malaysia and Germany

Aspect	Malaysia	Germany
Definition	Technology-enhanced language learning refers to a teaching approach blending conventional and contemporary strategies, utilizing cutting-edge instructional technologies (Luo, 2022). Chang and Hung (2019) also emphasize technology as a tool in language acquisition	The use of Internet platforms and pertinent media to improve teaching Chinese as a foreign language (Jiang, 2021). Luo (2022) also emphasizes the integration of modern instructional technologies
Use of existing mobile apps	Ling et al. (2019) examined the effects of mobile-assisted learning and traditional learning on Mandarin stroke writing among non-Chinese students. Deris and Shukor (2019) selected students to experiment with mobile apps for self-directed vocabulary learning	Users have a favorable attitude towards mobile touch devices (Liu et al., 2014)
Develop mobile apps	Ibrahim et al. (2017) created an educational mobile app for learning Chinese characters	Xin et al. (2020) developed an app for improving Mandarin proficiency for beginners
Virtual exchange program	Luo and Yang (2022) proposed a virtual exchange program promoting cultural learning and improving Chinese language proficiency	Luo and Yang (2022) identified virtual exchange benefits: cultural learning and language community creation
Mobile touch devices	Not widely used in primary education (Mahamad et al., 2016); traditional teaching styles are common (Jafri et al., 2020)	Liu et al. (2014) examined mobile touch devices in Chinese learning
Interchange	N/A	Schenker (2013) examined electronic contact between German and American students for cultural exchange
Blended teaching mode	N/A	Germany's basic education is less digitally advanced, and COVID-19 highlighted digital infrastructure gaps (Zhang, 2022). Blended teaching mode is preferred in higher education (Lin, 2022)

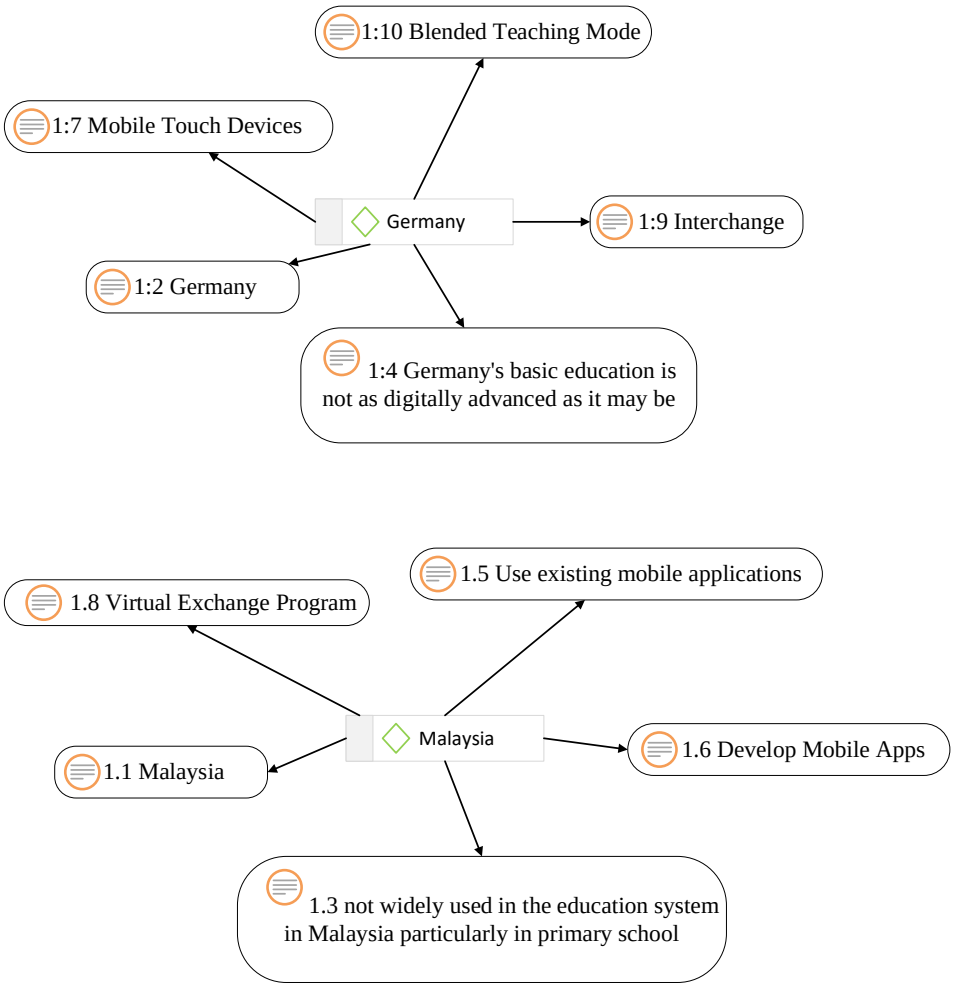

Fig. 1: Network comparing the integration of technology in learning Mandarin Chinese as a foreign language in Malaysia and Germany

3. Results

3.1. Types of technology used in Chinese language teaching and learning in Malaysia and Germany

Both countries applied mobile apps and technology tools that combine with an internet connection. It includes mobile language apps, WeChat, email, computer-assisted tools, and virtual platforms (Fig. 2). All the technologies are aimed to assist and enhance students' language performance.

3.2. Similarities and differences in technology integration

Table 2 summarizes the similarities and differences in technology integration between Malaysia and Germany regarding extent, frequency, challenges, and opportunities. Table 2 highlights that both countries have integrated technology into Mandarin Chinese language education, with similar technologies being used, such as online language learning platforms, mobile apps, and social media. Regarding the extent of technology integration, Malaysia and Germany have different levels of technology integration. Germany is known for its highly advanced technology, and its industries have incorporated technology into their operations for many years. In contrast, Malaysia has been increasing technology integration in recent years. Both countries strongly focus on digitalization and automation in various sectors, including manufacturing, healthcare, and finance. While in the frequency of technology integration, Malaysia and Germany have been actively integrating technology into their daily lives and business operations. In Malaysia, the government has been promoting the use of technology through various initiatives such as the Malaysia Digital Economy Blueprint and the National Ferberization and Connectivity Plan. German companies have been at the forefront of adopting new technologies such as Industry 4.0, which involves robotics, artificial intelligence, and the Internet of Things (IoT) to improve efficiency and productivity.

Moreover, Germany's level of technology integration is generally higher than Malaysia's, with German companies being more advanced in terms of their use of technology. It is partly due to Germany's long technological innovation and research and development (R&D) investment history. Nonetheless, both countries are moving towards greater technological integration at different rates. However, Germany has a higher level of digital infrastructure and access to resources, leading to a more extensive and frequent use of technology in language education than Malaysia. The challenges faced in technology integration include issues related to digital literacy, teacher training, and cultural factors, with Malaysia facing more significant challenges in these areas. The opportunities for technology integration include promoting language proficiency, enhancing intercultural communication, and improving learning outcomes. Overall, the comparison provides insights into the similarities and differences in technology integration in Mandarin Chinese language education in the two countries and suggests opportunities for future development in this area.

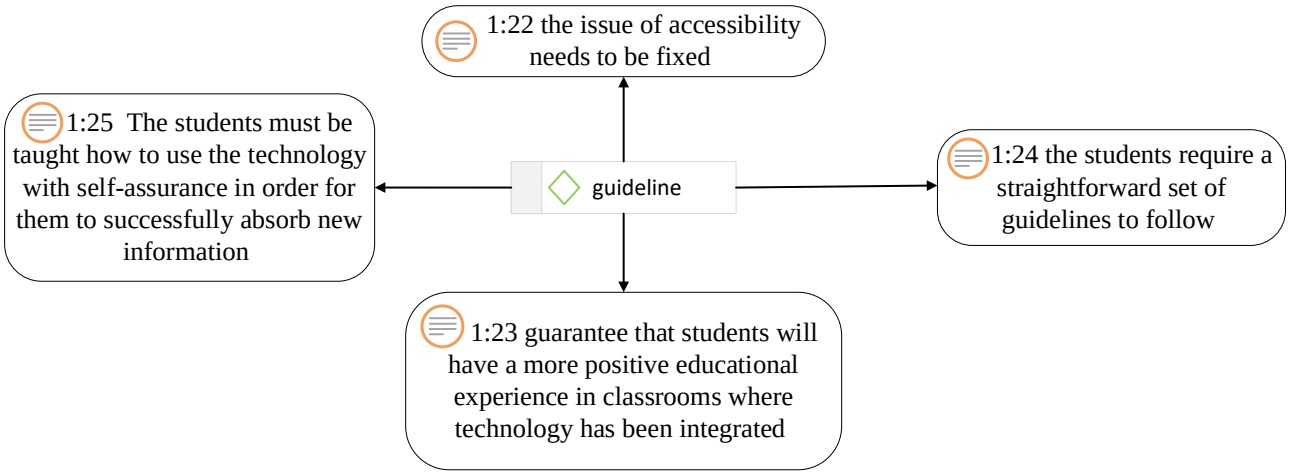

Fig. 2: The types of technology used in Chinese language teaching and learning in Malaysia and Germany

Table 2: The similarities and differences in technology integration between Malaysia and Germany in terms of extent, frequency, challenges, and opportunities

	Malaysia	Germany
Extent	Has been making efforts to increase technology integration in recent years	Known for its highly advanced technology
Frequency	Use technology as a tool	Being more advanced in terms of their use of technology
Challenges	Accessibility and lack of training	Accessibility and lack of training
Opportunities	Have great potentials	Have great potentials

3.3. Impact of technology integration

Table 3 presents the impact of technology integration on students' motivation, learning outcomes, and overall learning experience in Chinese language education in Malaysia and Germany. Table 3 highlights that technology integration positively impacts students' motivation and engagement in language learning, leading to increased language proficiency and improved learning outcomes. Both countries have reported similar benefits of technology integration in language education, including enhanced intercultural communication, increased student participation, and improved access to learning resources. However, differences exist in the level of impact, with Germany reporting a higher impact due to the more extensive and frequent use of technology in language education. Table 3 also identifies challenges associated with technology integration, such as issues related to digital literacy and teacher training, which may affect the overall impact of technology integration on language education. Overall, Table 3 provides insights into the impact of technology integration on students' motivation, learning outcomes, and overall learning experience in Chinese language education in Malaysia and Germany, identifying areas for future research and development in this area.

Table 3: Impact of technology Integration on Students' motivation, learning outcomes, and overall learning experience in Chinese language education in Malaysia and Germany

Technology Impact	Malaysia	Germany
Students' Motivation	Enhanced	Enhanced
Learning Outcomes	Improved	Improved
Overall Learning Experience	Need to be further explored	Need to be further explored

3.4. Attitudes of Chinese language educators and learners toward technology integration

Table 4 presents the attitudes of Chinese language educators and learners towards technology integration and their needs and preferences for technology-based language learning resources. Table 4 highlights that both educators and learners have positive attitudes toward technology integration in language education and acknowledge its potential benefits in enhancing language proficiency, cultural learning, and communication skills. Both groups also express a preference for technology-based language learning resources such as online language learning platforms, mobile apps, and virtual reality-based language learning. However, differences exist in the level of readiness for technology integration, with educators expressing a higher level of readiness than learners. Table 4 also identifies the need for more teacher training and support for educators to effectively integrate technology into language education and more student-centered and interactive learning resources to meet the preferences of language learners. Overall, Table 4 provides insights into the attitudes and preferences of Chinese language educators and learners towards technology integration in language education, identifying areas for future research and development in this area.

Table 4: The attitudes of Chinese language educators and learners towards technology integration and their needs and preferences for technology-based language learning resources

Attitudes	Malaysia	Germany
Educators	The involved teachers integrate technology as they enjoy it Practice	The involved teachers integrate technology as they enjoy it Practice
Learners	The learners enjoy technology-enhanced learning	The learners enjoy technology-enhanced learning

3.5. Recommendations and guidelines for effective technology integration

Integrating technology into the classroom and the learning process of Mandarin Chinese offers a tremendous deal of untapped potential to improve academic performance. Regarding education, there is a demand for additional instructional materials and training on how to use technology effectively. Teachers' ought to educate themselves on the most recent technological developments and get familiar with the various ways these can be used in the classroom. Increased teamwork is required to successfully generate sufficient materials that address the requirements of the students. On the other side, the issue of accessibility needs to be fixed to guarantee that students will have a more positive educational experience in classrooms where technology has been integrated. When a certain piece of technology is incorporated into the teaching and learning process, the students require a straightforward set of guidelines to follow. The students must be taught to use the technology with self-assurance to absorb new information successfully. How can we boost students' learning using different types of scaffolding and different sorts of social interactions? It is necessary to do additional research on a wider scale and with an expanded number of variables to gain a comprehensive understanding of technology's significant role. In sum, Fig. 3 depicts the network of recommendations, and Fig. 4 shows the guidelines derived from this study.

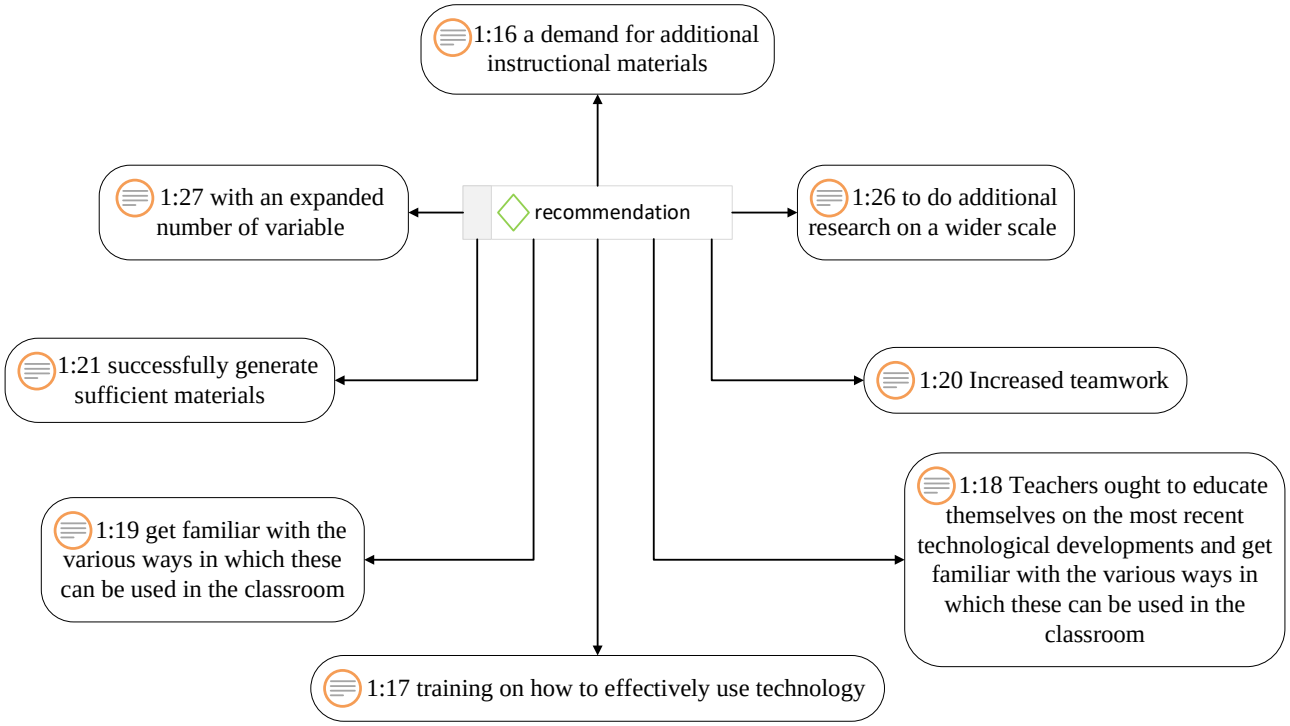

Fig. 3: Network of recommendations

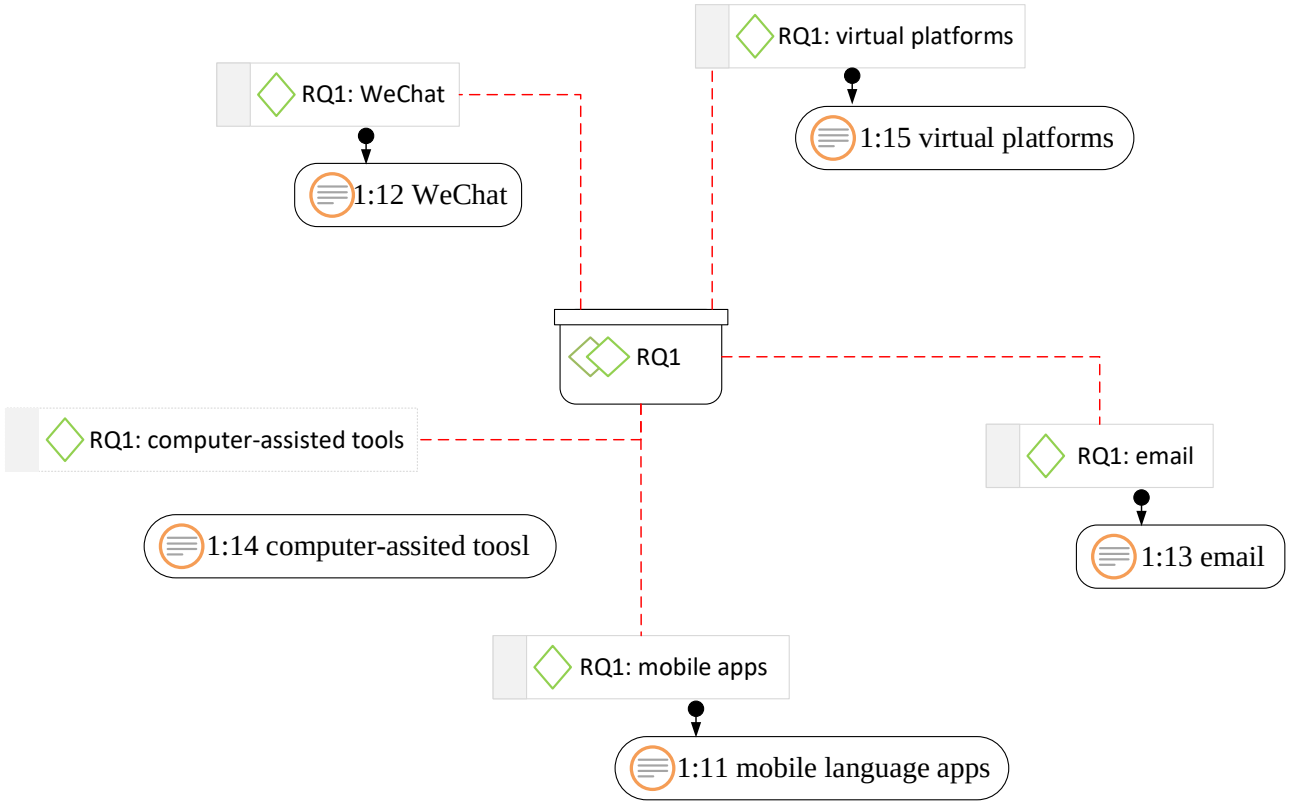

Fig. 4: Network of guidelines

4. Discussion

The overarching objective of the study is to determine how technology is currently integrated into Malaysian and German classrooms for teaching and learning Mandarin Chinese and to provide language educators and policymakers with insights into the effectiveness of technology integration in these culturally and linguistically diverse settings. The survey revealed that both countries employed smartphone apps and other internet-connected equipment. Mobile language applications, WeChat, email, computer-aided tools, and virtual platforms are included. It is found that all technology aids in language learning. It is done to compare Malaysia and Germany's technological integration in terms of breadth, frequency, issues, and future possibilities, as well as their similarities and differences. It is found that both countries have integrated technology into Mandarin Chinese language

education, with Germany having a higher level of digital infrastructure and access to resources. Challenges include digital literacy, teacher training, and cultural factors, while opportunities include language proficiency, intercultural communication, and improving learning outcomes. A significant result is that Germany, a nation renowned for its technological prowess, also struggles with digital literacy, particularly at the elementary education level, which is a major outcome of COVID-19.

Regarding efficiency, the finding shows that technology integration positively impacts students' motivation, learning outcomes, and overall learning experience in Chinese language education in Malaysia and Germany, with Germany reporting a higher impact due to its more extensive use. Challenges such as digital literacy and teacher training may affect the overall impact. Regarding the attitudes and preferences of Chinese language educators and learners towards technology integration in language education, educators express a higher level of readiness than learners. It also identifies the need for more teacher training, support, and student-centered and interactive learning resources. Lastly, to sum up, integrating technology into the classroom and the learning process of Mandarin Chinese offers the potential to improve academic performance. Teachers must educate themselves on technological developments, increase teamwork, and fix accessibility issues. At the same time, students need to be taught how to use technology with confidence. Additional research is needed to gain a comprehensive understanding of the significant role that technology plays.

The limitation of this study is the lack of comparative studies between Germany and Malaysia. It aligns with Hawamdeh and Soykan's (2021) study, where only 6% of German language studies from the 100 articles have been reviewed. It is clear because it reports that mobile learning technology is still less widely practiced in Malaysia. Mahamad et al. (2016) stated that Malaysian educators prefer the old teaching style (Jafri et al., 2020), and they found that Mandarin educators, as a foreign language, are inactive in using technology in their practice (Navarre, 2018). This is also the case in Germany (Zhang, 2022). As reported with the outbreak of COVID-19 in basic education in Germany, it was found that digital education is not advanced. This is because there are many problems with the development of digital education, and they are different in each area/federal. It is also found that education is more supported by the blended teaching mode, as stated by Lin (2022). However, it was found that both countries have implemented technological integration in education. It is found that there is a wide range of applications and modern technologies in the existing market that are the choice of educators and students for teaching and learning Mandarin. Apart from using the existing applications, educators of both countries also showed that there is an effort to develop applications for improving students' Mandarin language skills. The application of technology in higher education was found to be more advanced in Germany (Schenker, 2013), Turkey (Küsel et al., 2020), and Malaysia (Luo and Yang, 2022). The latest technologies, such as virtual reality (DeWitt et al., 2022) and artificial intelligence (Chua et al., 2021), are also integrated into Mandarin language education in Malaysia and Germany and have proven effective. But for the best results, researchers in Germany say that the government needs to reduce bureaucratic constraints and educators need to strengthen the teaching method with the help of technology to pay attention (Kerres, 2020).

In sum, integrating technology into learning Mandarin Chinese as a foreign language benefits Malaysia and Germany. In Malaysia, technology such as online platforms and mobile applications has been found to enhance students' engagement, motivation, and proficiency in the language. Additionally, multimedia resources and virtual reality technology have facilitated students' cultural understanding of the Chinese language and society. In Germany, integrating technology into Mandarin Chinese learning has been found to improve students' speaking, listening, and reading skills. Online language resources and computer-assisted language learning programs have been particularly useful in promoting autonomous and independent learning among students (Rahmawati and Saputra, 2022).

5. Conclusions

In conclusion, technology integration in Mandarin Chinese language education was effective in both Malaysia and Germany. Various digital tools and platforms were utilized to enhance teaching and learning. While both countries have faced challenges such as digital literacy, teacher training, and cultural factors, the opportunities presented by technology, such as language proficiency and intercultural communication, have been determined to outweigh these obstacles. With its superior digital infrastructure and resource access, Germany has reported a greater impact on technology integration, whereas Malaysia has demonstrated a willingness to implement and employ new technologies. Despite these positive results, there is still a need for additional research and teacher training to realize the potential of technology in Mandarin Chinese language education completely. There is a need for both educators and students to be more confident and competent in the use of technology for language learning and for more student-centered and interactive resources to be created. Due to the COVID-19 pandemic, there is an urgent need to develop and implement digital solutions to support teaching and learning. Governments must provide the necessary infrastructure and support to make this possible. Integrating technology into Mandarin Chinese language education provides a promising avenue for enhancing academic performance and intercultural comprehension.

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Compliance with ethical standards

Conflict of interest

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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