

Augmented Reality for Quechua Language Teaching-Learning: A Systematic Review

<https://doi.org/10.3991/ijim.v17i06.37793>

Jhonatan Cardenas-Valdivia¹, Jean Flores-Alvines¹,
Orlando Iparraguirre-Villanueva¹, Michael Cabanillas-Carbonell²(✉)

¹Universidad Autónoma del Perú, Lima, Perú

²Universidad Privada del Norte, Lima, Perú
mcabanillas@ieee.org

Abstract—With the passage of time, the advancement of technology is evident, Augmented Reality (AR) is an innovative technological tool that has emerged and has been highly attractive to users, allowing the sharing of information in a dynamic and realistic way. In the present systematic literature review (SLR), a search was conducted for manuscripts published in 6 databases between the years 2017 to 2022, related to the implementation of AR to improve the teaching-learning (TL) process of the Quechua language, which were analyzed and systematized using the Prisma methodology, resulting in 56 manuscripts that supported answering the research questions, where the various factors that allow improving the TL process of the Quechua language and the various benefits generated by its implementation were identified. It is concluded that, according to the results, the application of AR in the TL of the Quechua language is an efficient and productive tool; however, it can also be a source of distraction in the study, so it is necessary to have good management of this methodology and the study environment to obtain better achievements. For this reason, we propose a model that serves as a basis for proper management in the application of AR to improve the process of the Quechua TL language.

Keywords—augmented reality, Quechua, learning, review

1 Introduction

AR is a type of technology that superimposes information in the real world, which can be visualized from a technological tool, to interact and enrich various types of information, according to [1][2], there are different types of AR, including visual augmentation, haptic feedback and multimodal feedback [3]. AR like many digital technologies encompasses algorithms, which, in this case, allow to distort of reality, counting with additional information which is attractive to the user [4][5], being so, this tool joins the 3 dimensions of the elements created in a digital way, texts, images and real videos, visible in a real-world [6], AR technology nowadays covers different fields, as well as AR applied in education, video games, medicine, architecture, etc.,

taking into account that many of them have the objective of raising awareness about certain topics and instructing greater knowledge, which is a support for society [7].

Learning is a continuous and dynamic process that takes place innately, from the surrounding environment, lessons acquired by the teacher, and the need to investigate or learn about a specific topic that needs to be learned [8]. Nowadays there are tools that facilitate and optimize the teaching-learning process (TL), which help to acquire and understand new knowledge [9]. The TL methods have no limits since it is possible to teach-learn virtually, being applied since previous decades, with the support of virtual tools and platforms that arise from the need to improve [10],[11]. In this way, it is possible to have diverse teaching options, since the virtual environment can be a complement to acquiring more knowledge, creating an interactive TL process capable of attracting the student's attention and interest to continue learning [12].

Indigenous languages represent mestizo cultures, which today are marginalized by other higher elites [13], so there was no reason to be proud, leaving aside the linguistic diversity that exists today in Latin America, where in many cases are in danger of extinction [14], as mentioned [15] factors that influence the loss of Quechua language in students is fashion, followed by migration and technology, [16] mentioned factors such as homeschooling, pressure from society and lack of publicity, [17] indicated that social networks today are in different languages but not in Quechua, excluding a large part of the population of Argentina, Peru, Chile, Ecuador and Colombia [18] showed that in some way they want to rescue the Quechua language through the promotion and cultural exchange, as mentioned [19] Another way to rescue the Quechua language is taking advantage of new technologies, as is the case of AR, being an attractive tool for users which can encourage TL in a dynamic way.

Therefore, the present research is justified by the application of AR to improve the TL process of the Quechua language to preserve indigenous mother tongues. The present systematic review aims to identify the factors and benefits provided by RA to improve the teaching and learning process of the Quechua language.

2 Related work

The TL of languages is complex [20], some factors that influence according to [21] are due to traditional methods, deprivation of opportunities, outdated session templates, and poor social commitment, as evidenced in the Quechua language, which does not guarantee the level of equity and formative quality for the preservation as a mother tongue, its culture and territorial identity [22]. According to [23] the new technological tools seek to reduce the weakening of indigenous languages, allowing them to preserve of the cultural identity of Andean and indigenous peoples, but their application is very scarce. [24] mentioned that children from a very early age already have within reach a smart mobile device and even with internet connectivity, however, they often use it for leisure, even so, it would also be performing a learning process innately on what they visualize. Thus, [25] emphasized that the combination of technological tools such as AR together with traditional technologies is an optimal

model for an adequate TL space of a new language in children, which allows the formation of intercultural and sociocultural competencies of students. In [26] mentioned that the use of RA helps teachers to better focus the teaching process facilitating the learning of students, who show interest, motivation, participation in the topics, and the desire to continue acquiring knowledge, demonstrating that RA is a tool with great potential in education. In [24] the use of AR improved reading comprehension and the learning of language vocabulary, and even the comprehension of conversation between children and adults, which showed the motivation generated by the use of AR, [27] demonstrated that AR applied in the process of language TL is an innovative technology, generating motivation in students, thus better results in language learning were observed. [28] highlighted 29 technologies applied in the TL of languages, among them the RA, these allow teachers to organize their topics, and generate interest and motivation in students, thus can generate interest in learning various languages that are becoming extinct, so [29] indicated that it is important to support and train teachers on the use of technological tools, to teach adequately to their students. In [30] showed that compared to teaching with traditional materials, AR improves learning performance, with the use of animated images or 3D objects, allowing the retention of knowledge and understanding of abstract concepts, likewise in [31], demonstrating the influence of AR applied in language teaching and digital storytelling, obtaining an effective result since AR is an attractive and interactive tool that allows enjoying the knowledge acquired and insights to inquire more about the topics. In [32] mentioned that introducing students to virtuality, generates motivation, and interaction and allows for reducing the anxiety generated by learning. [33] mentioned that according to his research, there is a preference for developing AR-based games for learning a new language rather than using ready-made commercial games, likewise [34] managed to analyze the most accessible platforms for creating applications with AR. In this way, [35] in his research, by applying games with AR he obtained very efficient results in the TL process.

[36] highlighted that internet access, size of the interface, usability, and technical challenges of the tool with AR prove to be limitations of a student and teacher for the TL process, likewise [37] highlighted socio-economic limitations, the importance of competent educators who know how to handle a tool with technology, threats, privacy and security issues that a student presents with the use of AR, on the other hand, their study determined that AR is a highly effective tool that allows improving the TL of a language. In [38] analyzed the impact of AR and the influence of its mastery in the TL process, presenting that AR has a medium impact on student learning, so it is recommended to inquire more about the benefits of it and take full advantage of it to obtain better achievements, in the same way, [39] in his study obtained that although the benefits of AR applied to language TL are obtained, it is still not entirely suitable, because it is not specially designed for education so that its domain does not fit completely when applied, however, the great potential can completely dominate the field of language TL in the future along with other technologies. In this sense [40] mentioned that AR applied alone to TL is not enough to master a language, so good management of the thematic curriculum and a proper methodology is of great importance to ensure the TL of a new language. Thus, [41] indicated that according to

their findings, AR is one of the most widely used tools for TL of vocabulary, reading, speaking, writing and other skills in the performance of a new language.

3 Methodology

The present research is carried out with the PRISMA methodology for the review of articles according to the research, on the other hand, the bibliometric analysis is applied to determine the research from which the factors that allow the improvement of TL and the benefits provided by the application of RA in TL of the Quechua language will be analyzed, which will allow achieving the objectives. The SLR study presents an evaluation of the contribution of new technologies, in this case, AR, applied to the learning and teaching of the Quechua-Peruvian language.

The Prisma method consists of the following steps: a) Identify manuscripts related to the topic, b) Exclude screening of the full manuscript, c) Eligibility screening, d) Selection of final manuscripts for detailed analysis.

The bibliometric map was applied to represent the frequency and relationship of the common terms involved in the study. Thus, the terms were measured according to the frequency of each one, the quantity of the most used terms, and the frequency of these terms in the manuscripts reviewed in this research study. According to PRISMA, the following structure is followed: a) definition of research questions; b) manuscript search strategies; c) application of inclusion and exclusion criteria, and d) selection of final manuscripts.

3.1 Research questions

This research aims to review research that applies new technologies to improve the TL of the Quechua language, which is why the following research questions are posed.

Table 1. Research questions

RQ	Research Questions
RQ1	How can RA improve Quechua language teaching?
RQ2	How can RA improve Quechua language learning?
RQ3	What are the benefits of RA applied to Quechua language learning?

3.2 Search strategy

A search for published manuscripts was conducted in reliable databases, which allow us to answer the research questions as shown in Table 1, the search was conducted in 6 databases, being the following: Scopus, Taylor & Francis Online, ScienceDirect, Google Scholar, IEEE Xplore, EBSCOhost; from which it was possible to identify and analyze potential preliminary researches referring to the research topic and that contribute to the development of the present research work. In this way, the selection of manuscripts related to the RA topics and TL of the Quechua language was estab-

lished. The search was carried out through publications of manuscripts that include in the title or in their content the expression of keywords as shown in Figure 1.

(Augmented reality) AND (learning) AND (languages)

Fig. 1. Manuscript database search string

3.3 Inclusion and exclusion criteria

Phase 1: The search string was performed in the databases mentioned above, those between the years 2017 and 2022, from which 1318 publications were obtained. Table 2 shows the inclusion and exclusion criteria for selecting the articles.

Table 2. Inclusion, Exclusion, and justification criteria

Inclusion criteria	Exclusion Criteria
Studies related to RA applied to the teaching and learning of the Quechua language.	Short documents
Studies published in the last 4 years (2019-2022).	Studies unrelated to the subject matter
Original articles that follow a research methodology.	Duplicate items
Reliable Database Articles	Articles in Spanish

3.4 Final selection of articles

Phase 2 continues with the selection of the final manuscripts, the process carried out is shown in Figure 2, which shows the flow chart according to Prisma, according to the four steps mentioned above: in the initial search for manuscripts 397 publications were obtained, in step 1, 29 publications were excluded according to the exclusion criteria and duplicate manuscripts, in step 2, 269 publications were excluded after the analysis of the abstract of the documents, in step 3, 99 publications were obtained after the eligibility analysis, finally, in step 4, 43 publications were excluded and, giving as a final result a total of 56 publications after the analysis of the manuscripts with their reasons.

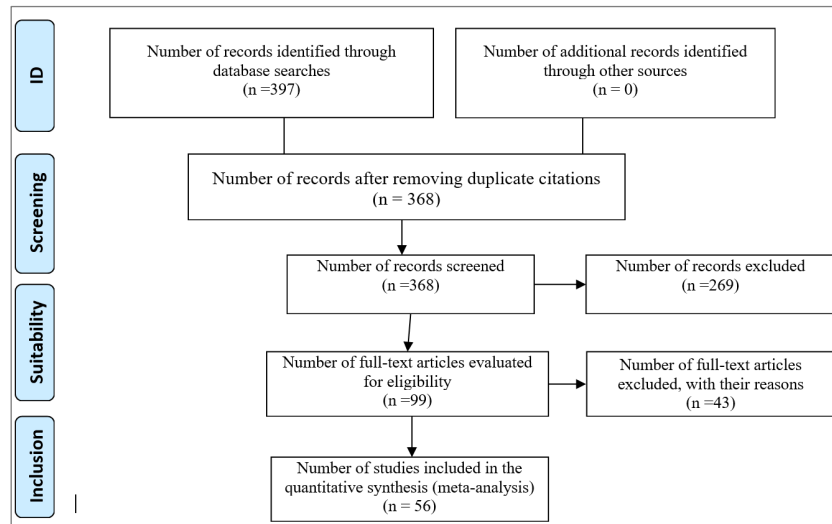


Fig. 2. Prism Flow Diagram

Figure 3 shows the articles by database, showing that the Scopus database has the largest number of articles related to RA and TL of the Quechua language, followed by Google Scholar, EBSCO HOTS, Science Direct, Taylor & Francis, and IEEE Xplore, respectively.

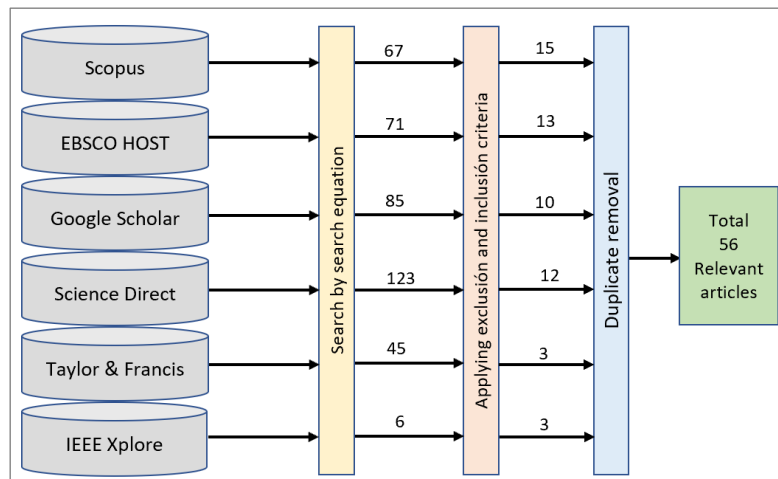


Fig. 3. Graph of results obtained in the search

Phase 3: The selection of the articles that did not give rise to an exclusion criterion was 81, these were grouped into topics related to the research questions, as shown in Tables 3, Table 4, and Table 5.

- Studies associated with improving Quechua language learning by applying RA.
- Studies associated with the benefits of applied RA in the learning of the Quechua language.

Table 3. Studies associated with factors that help to improve the teaching of the Quechua language by applying the AR

#	Ref.	Application	Factors to improve teaching
1	[42][43][44]	AR applied to education	An innovative tool increases students' motivation and allows them to express their doubts.
2	[45][46][47][22][48]	Prototype for Teaching-Learning with AR	Facilitates the TL process, student interaction, attractive and motivating.
3	[49][50][51][52]	AR in English Language Teaching	An optimal model with the combination of AR and traditional teaching
4	[53][54]	AR for English vocabulary instruction	Facilitates teacher's performance, with visualization of 3D animations
5	[55][56][57][58]	AR in foreign language teaching	Easy acquisition of concepts through AR by scanning QR codes, allowing better grasp of the subject matter
6	[59]	AR applied in CLIL methodology	Teacher can design their own videos with AR accessible to their students
7	[60][7]	AR Picture Books in Language Teaching	Interactive narrative design effect allows for active studying
8	[61][62]	AR games for the teaching of English pronunciation	The creation of 3D animations, capturing the student's attention and interest.
9	[63]	AR for teaching and retrieving Chinese radicals	The teacher is a guide in the AR experience to generate effective learning.
10	[64][5]	Smart Classroom with AR	The cooperation of the students is achieved, they express their doubts.

Table 4. Studies associated with factors that help to improve the learning of the Quechua language, applying the AR

#	Ref.	Application	Factors to improve learning
1	[45][46][22][48]	Prototype for Teaching-Learning with AR	The use of scanned images allows for better understanding, and is attractive, motivating and motivating.
2	[65][66][67]	AR applied to Quechua language learning.	The combination of the real and virtual world attracts students' interest
3	[68][69]	AR applied to English language learning	Learning is dynamic for students
4	[70][71]	AR applied to vocabulary learning	Interesting, easy to use, and attractive tool
5	[53][54]	AR applied in English language vocabulary instruction	3D animations with AR allow enjoying the acquired knowledge
6	[72][10][12]	AR for deep learning skill enhancement	The use of SC-AR model and didactic materials stimulates learning
7	[73]	Learning assessment with AR	The use of AR generates feedback, suits a motivating study habit
8	[74]	AR for learning Japanese phrasal verbs	Scanning animations using a mobile device

#	Ref.	Application	Factors to improve learning
9	[75]	AR applied to French language learning.	Scanning animated images allow the conceptualization of terms
10	[76][77]	AR applied in language learning	The use of 3D objects in the real world allows the learner to dig deeper into the subject matter
11	[61][62]	AR games for learning English language pronunciation	Content in 3D animations, text, video, and audio with AR enables reasoning
12	[78]	AR applied in language learning through stories	Reading comprehension response tests with AR generate learner interest
13	[5][1][4]	Smart Classroom with AR	Efficient and productive as AR can be used on smartphones.

Table 5. Studies associated with the benefits of AR as applied to Quechua language learning

	Ref.	Application	Benefits of RA
1	[45][46]	AR for teaching and learning a language.	Improves traditional methodologies and overcomes restrictions such as printed materials.
2	[22][48]	Mobile application with AR for Quechua language learning.	Achieves a connection with the environment, and reduces the weakening of mother tongues and cultural identity.
3	[76][77]	AR applied to language learning	Reduces anxiety levels, enhances creativity, and increases student engagement.
4	[10][3][2][12]	AR scaffolding for improving deep reading skills	Readers have a better understanding and enjoyment of what they read, developing critical thinking.
5	[74]	AR for learning Japanese compound verbs	Allows retention of knowledge compared to paper-based materials.
6	[70]	AR applied in vocabulary learning	Generates better comprehension, good study habits, and a positive attitude toward learning.
7	[60][7]	AR picture books in German language learning	Generates students' interest in learning, generating better reading comprehension.
8	[79][62][61]	AR games for English language pronunciation learning	Maintains a student's interest and motivation, through games with AR, generating critical ability.
9	[78][80]	AR applied in language learning through storytelling	Reading comprehension tests with AR allow the student to demonstrate correct comprehension in a dynamic way.
10	[64][4][1][81][5]	Smart Classroom with AR	It is efficient and productive, complementing reality rather than replacing it.

4 Results

This stage details the bibliometric analysis and the analysis of the manuscripts reviewed. The first part visualizes the relationship between the most used terminologies with respect to AR applied in TL of the Quechua language. The second part aims to find the scientific gap between the works analyzed in this review article, to develop a novel model that allows users to use AR for TL of the Peruvian Quechua language

4.1 Bibliometric analysis

VOSviewer is a bibliometric visualization network [82] used to identify the relationship of the most used terminologies in a manuscript. Thus, it has made it possible to visualize the relationship of keywords such as augmented reality, learning, teaching, language, technology, and Quechua. A network map is visualized in Figure 4, which shows the relationship between the most frequently used terminologies in the manuscripts reviewed. The size of the nodes refers to the frequency of the most frequently used terminologies, with the largest node being the most frequent terminology in the manuscripts. For this purpose, the terminologies involved in the titles and in the abstract of the manuscripts were analyzed by means of a binary count, where 212 keywords were examined at a minimum threshold of 2 occurrences, obtaining 25 terminologies. The larger nodes represent each cluster in the network map, as follows: augmented reality cluster (light blue), language learning cluster (orange), ar cluster (green), educational technology cluster (purple), higher education cluster (blue), arcs model cluster (red), vocabulary learning cluster (brown) and early childhood education cluster (yellow).

As shown in the network map in Figure 4, the 8 clusters are linked to each other, the term "augmented reality" is linked with "educational technology", "mobile learning", "game based learning", also connected with "arcs model", "augmented reality(ar)", "english as a foreign language", "english learning", "immersive learning", likewise with the orange cluster "language learning" and "virtual reality", with the yellow cluster "early childhood education", "english as a foreign language", "information and communication", "interaction", with the green cluster "ar", "learning motivation", "learning performance", "mobile application", in the same way with the blue cluster "higher education", "motivation", finally "augmented reality" is linked with the brown cluster "vocabulary learning".

Figure 4 also shows the density of keywords identified in the analyzed manuscripts. The term augmented reality is the terminology with the highest recurrence found in the bibliometric analysis, where it is identified that the term augmented reality is the terminology with the highest recurrence.

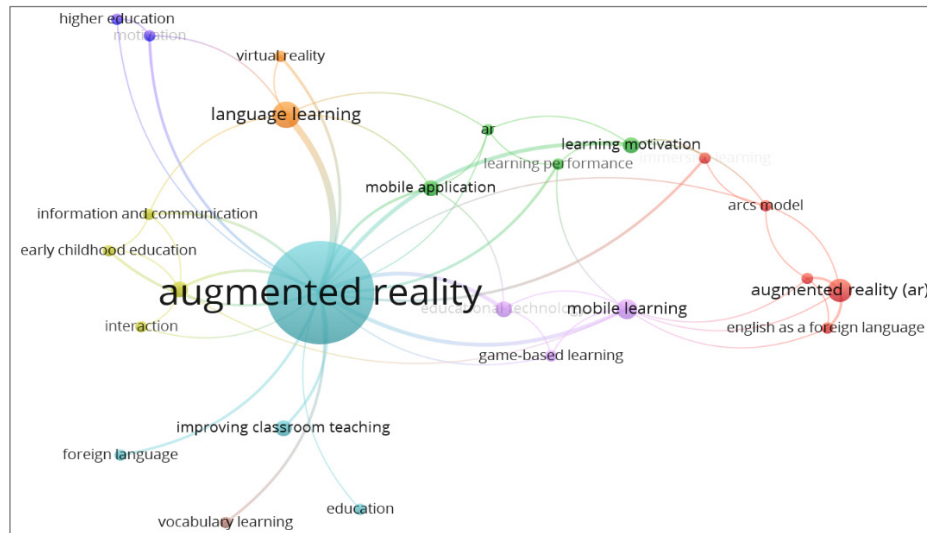


Fig. 4. Relationship between common terms used in bibliometric mapping

Finally, we analyzed the network map in Figure 4 and visualized the density of documents, where we found twenty-five (25) items, grouped in 8 clusters: Cluster 1 red color, "Arcs Model"; Cluster 2 green color, "AR"; Cluster 3 light blue color, "Augmented reality"; Cluster 4 yellow color, "Early Childhood Education"; Cluster 5 purple color, "Educational technology"; Cluster 6 blue color, "Higher education"; Cluster 7 orange, "Language learning" and Cluster 8 brown, "Vocabulary learning".

4.2 Manuscript analysis

For the present systematic review, 6 online databases were used, a total of thousand three hundred and eighteen (1318) manuscripts were initially found, of which EBSCOhost initially obtained 123 documents, 102 were discarded after applying the exclusion criteria, Google Scholar obtained 618 after exclusion 598 were discarded, IEEE Xplore obtained 6 documents, discarding 3, Science Direct 254 documents, discarding 247, Scopus 144, discarding 117 and finally Taylor & Francis Online 179 documents initially, discarding 176. After applying the exclusion criteria, a total of 81 research articles were obtained, as shown in Figure 5, which contributed significantly to this systematic review article.

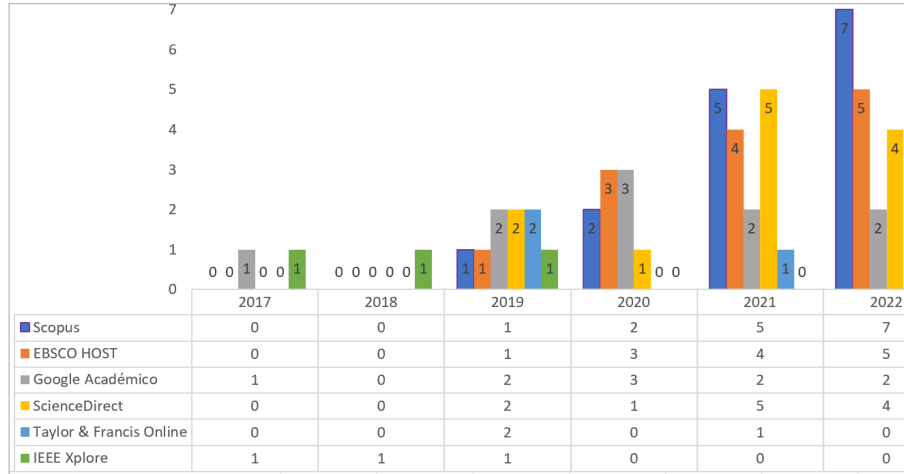


Fig. 5. Articles by year and database

Figure 5 shows the number of manuscripts published by year and database in a bar chart, where it can be seen that in the years 2021 and 2022, the highest number of publications was obtained, with Scopus and EBSCO HOST being the databases with the highest and lowest number of publications in those years respectively. Likewise, in 2017 only 2 publications were obtained, corresponding to IEEE Xplore and Google Scholar. Figure 6 shows the number of manuscripts published by continent, with the highest number in Asia, with 19 manuscripts, followed by America with 18, Europe with 17, and the lowest number in Oceania and Africa, both with 1 manuscript each, so that for this research there was little evidence of related studies that contribute to the subject, with respect to the last-mentioned continents.

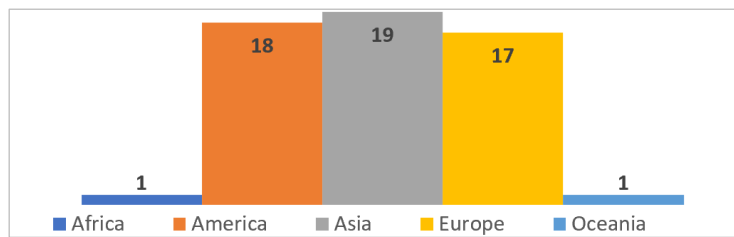


Fig. 6. Articles by continent

Figure 7 shows the number of articles published by country, which is on a scale of 1 to 13, with Peru having the highest number of manuscripts found, given that Peru is a country where one-third of the population speaks Quechua. The lowest number of articles published in the Quechua language was in Germany; Argentina, Chile, South Korea, Egypt, Finland, Japan, Jordan, Pakistan, Portugal, United Kingdom, and Thailand, with 1 manuscript in each country.

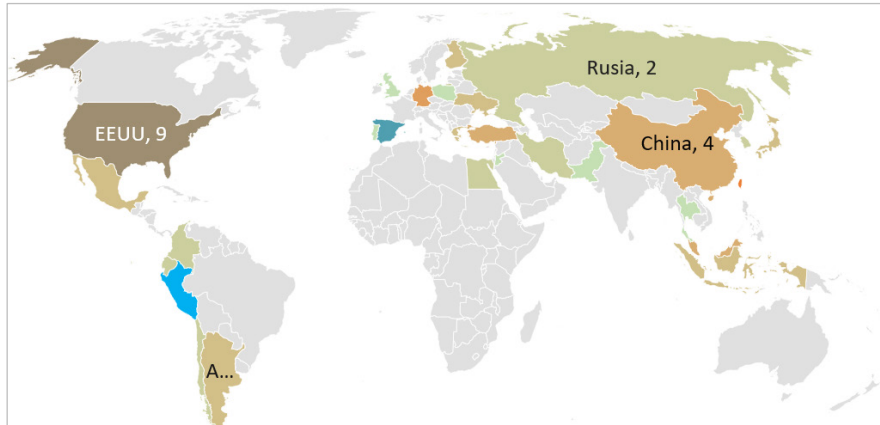


Fig. 7. Articles by Country

Figure 8 shows the most used keywords in the manuscripts, obtaining the 25 most relevant keywords, it is identified that augmented reality is the most mentioned by the authors, with 37%, followed by language learning with 6%, the Quechua language is observed with 5% and mobile learning with 4%.

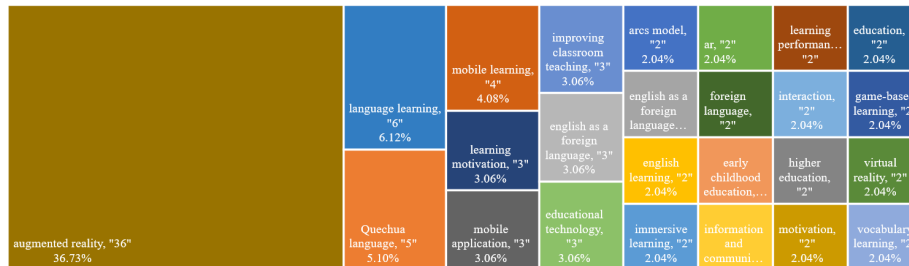


Fig. 8. Author's keywords

5 Discussion

RQ1, In the present research we identified several factors that allow us to improve the teaching of the Quechua language by applying AR, as shown in Table VIII, it was found that AR is a technological tool that today is available to people from a very early age [43], so that according to [42][43] an AR application is an innovative tool when applied in a classroom, which allows us to keep the attention of students motivating them to continue learning. Similarly, [22][45]-[48] mentioned that this technology facilitates the TL process, [49]-[52] showed that AR alone would not be effective for language TL, but that the combination of traditional methodology with the application of AR results in an optimal model, in [61] they found that the interaction of 3D animations attracts the student's interest, These same in [53][54] allow the teacher to better explain the topics since the visualization of the animations enriches

the conceptualization acquired by the students, an important factor that, in [63] mentioned that the teacher is an important factor as a guide of the experience. Thus, the importance of training teachers in new technologies. Figure 9 shows the articles by a factor that allows for improving teaching. For example, 6 articles were found on 3D animations with AR, where it is specified that 3D animations capture the attention and interest of students. Similarly, 5 articles were found for the factors: scanning of QR codes that allow a better grasp of the topics, optimal model, iterative, attractive, and motivating, respectively.

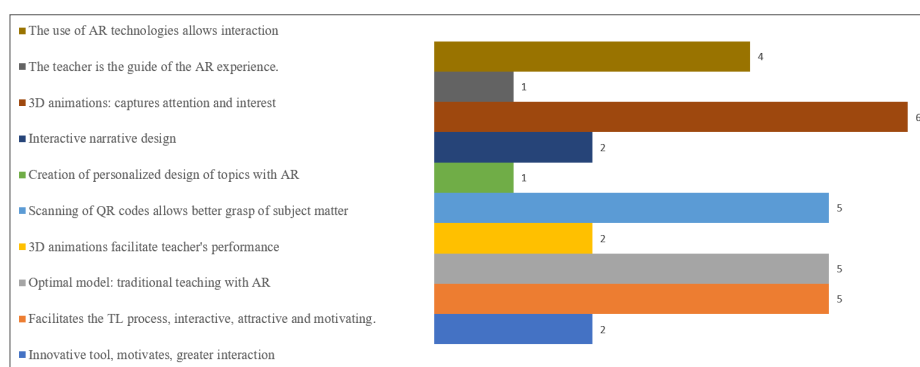


Fig. 9. Number of items per factor that allow for better teaching with RA

RQ2, allowed for the identification of the various factors that improve the learning of the Quechua language, as shown in Figure 11 It was found that the application of AR for learning allows combining the real and virtual world allowing to attract the student's interest [65] in this sense [22][45] mentioned the ease of scanning 3D animations which is attractive and motivating for the students, likewise in [53][54] it was found that these animations allow enjoying the acquired knowledge and even in the visualizations they generate that the student wants to investigate more about the subject, This agrees with [61] who found that the use of 3D animations, texts, video, and audio generate critical reasoning, in [75] they allowed a better conceptualization of terms and in [73] it generated feedback and a motivating study habit, all of which resulted in an interesting, easy to use and attractive tool. Figure 10 shows the number of articles for each factor to enhance learning with AR. For example, we found 10 articles related to iterative tools with 3D animations and AR; 9 articles related to dynamic learning; 8 articles related to AR models and didactic materials, respectively.

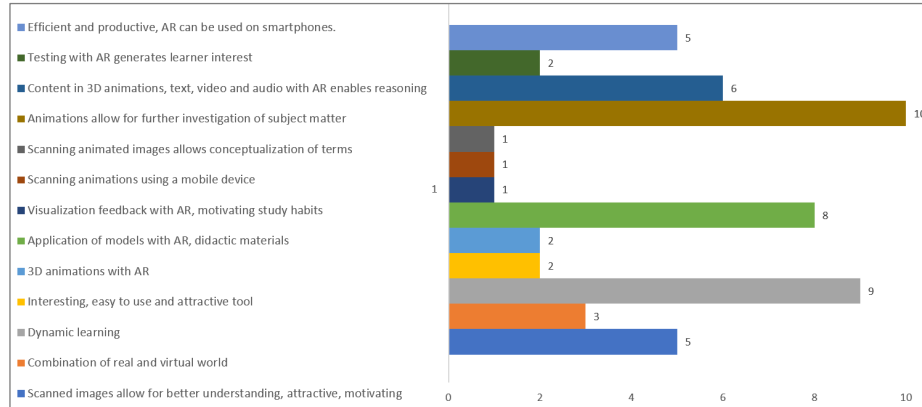


Fig. 10. Factors that enhance learning with RA

RQ3, the present research allowed us to identify the benefits of RA applied to Quechua language TL, as shown in Figure 11. Likewise, the following research works[22][45] are in line with the results of this work, since they applied RA to language TL to improve traditional methodologies with the aim of obtaining better achievements. Similarly, in [64] it proved to be very efficient and productive since it aims to complement reality but not replace it. In [74] showed that applying RA allows better retention of knowledge, which agrees with [48] where it was shown that it generates better understanding, innovative study habits, and positive attitude, likewise [7][60] mentioned that it generates better reading comprehension, which agrees with [12] where they found that readers enjoy what they read, thus developing critical thinking. Similarly, in [78] they indicated that it is a dynamic way of TL in a new language.

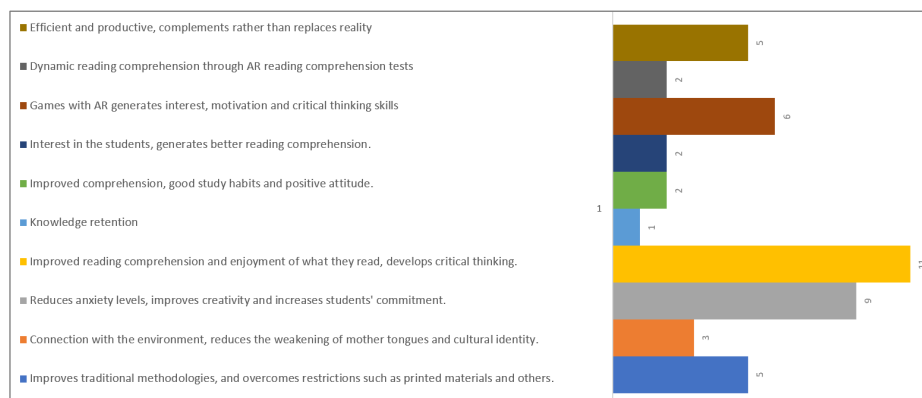


Fig. 11. Benefits of AR in teaching Quechua language learning

In [61] they showed that games with AR generate interest and motivation to learn a new language, which allows them to better grasp the terminologies, in the study [76]

they showed that this type of technology reduces the levels of anxiety and stress generated by the TL process in a student and also improves creativity and increases the commitment to continue learning. Figure 11 shows the articles related to the benefits that RA generates in the teaching and learning of the Quechua language. For example, 11 articles were found related to RA, where learning with RA tools reduces anxiety levels, helps improve creativity and increases student engagement. We also found 9 articles that state that RA improves reading comprehension and enjoyment of what they read, and 6 articles related to RA, which indicate that games with RA generate interest, motivation, and critical thinking skills.

6 Proposed model

This section proposes a model that fits the need to implement RA to improve the TL of the Quechua language, which serves as a guide to identify the factors that should be considered for its application and to analyze the benefits provided by this methodology. The model consists of 3 phases: identification of elements, planning to apply the RA, and evaluation of the methodology.

6.1 Identification of elements

This first phase consists of identifying the main elements involved in the process of TL of the Quechua language using AR. In the first place, we have the students, and we must consider their academic level, familiarity, and scope they have with the technology for the adequate preparation of the topics; followed by the teachers who are responsible for the TL, which is why they must be trained to guide in the operation and use of technological tools, finally, the mobile application with AR, since it is essential for the visualization of the topics with AR.

6.2 Planning of the proposed model

In this phase, the methodology to be applied is organized, which will allow for obtaining a better result in the TL of the Quechua language. The capacity and access to an intelligent mobile device for the visualization of 3D animations are considered, and the AR application must have an agile, simple, and friendly interface for users who can manipulate it without the need to be experts. Teachers will have access to RA creation platforms for the development of their topics, organized in an index that is available to students, which can interact through a combination of traditional and technological methodology (RA), and even the implementation of didactic games or questions with RA in the process of TL of the Quechua language with the methodology in question.

6.3 Methodology evaluation

In this last phase, the results obtained in the student evaluations are analyzed, and the level of achievement obtained in the TL of the Quechua language is organized and presented, in accordance with this lies the importance of implementing new improvements in the traditional teaching methodology together with the AR. In accordance with the approach, the proposed model consists of 3 phases, as shown in Figure 12.

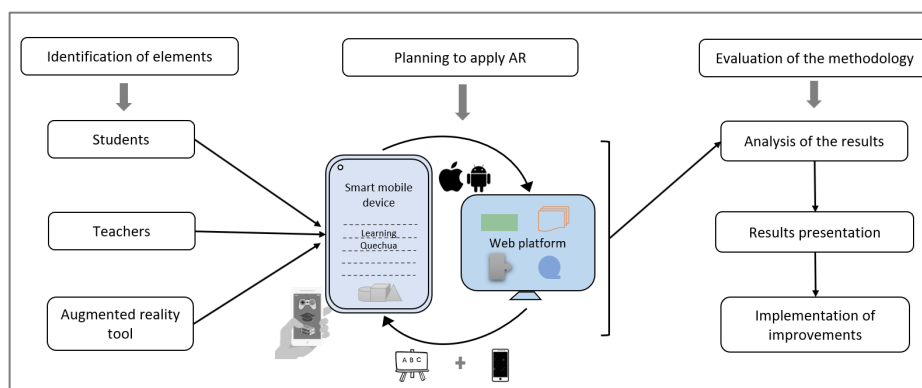


Fig. 12. Architecture of the proposed Model

7 Conclusions

In this study, a review of 56 research articles was carried out, after a selection process that considered the inclusion and exclusion criteria. These articles were obtained from 6 databases published between 2017 and 2022 and were identified by the number of manuscripts per year, continent, and country. The research questions initially posed were answered, making it possible to identify the various factors that allow the AR tool to improve the TL process and therefore generate a productive methodology for the TL process of the Quechua language; It is highlighted that it is an innovative technology applied in the study, it is also possible to use the games with AR as a methodology of TL in the study, generating interaction and feedback of concepts with 3D animations, thus greater interest, and greater interaction between student-teacher, this tool can complement traditional teaching methods and be of great support for teachers, so it becomes an efficient and productive tool. In addition, the benefits provided by the RA in the TL of the Quechua language were identified, where the use of this methodology allows to preserve and connect the cultural heritage and indigenous languages that are forgotten, generating motivation to students to learn more about the culture, students can enjoy what they read and better grasp the new concepts they learn, on the other hand, it is noted that it manages to reduce anxiety levels in students generating a new habit of study, they would be learning a new language in a didactic way. However, for RA to be highly effective, it is important to manage the entire

study environment, as it can also be a distraction if the necessary considerations are not considered. Therefore, a model is proposed that meets the general requirements for the implementation of RA in the TL process, where RA can complement traditional TL methods but not replace them.

It is recommended for future research to thoroughly search for research in various databases, six of which were used in this study. This study will serve as a basis for future research on the teaching and learning of various languages on the road to recovery, which is currently becoming extinct.

8 References

- [1] A. N. Rosman, N. A. Samsudin, A. Ismail, M. S. Aripin, and S. K. A. Khalid, “Augmented reality application for location finder guidance,” *Indonesian Journal of Electrical Engineering and Computer Science*, vol. 13, no. 3, pp. 1237–1242, 2019. <https://doi.org/10.11591/ijeecs.v13.i3.pp1237-1242>
- [2] H. Hyder, G. Baloch, K. Saad, N. Shaikh, A. B. Buriro, and J. Bhatti, “Particle Physics Simulator for Scientific Education using Augmented Reality,” *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 2, pp. 671–681, 2021. <https://doi.org/10.14569/IJACSA.2021.0120284>
- [3] J. Sánchez-Sordo and S. Teodoro-Vite, “Development of an augmented reality environ,” 2022. <https://doi.org/10.51302/tce.2022.862>
- [4] A. Ballesteros, “Digital technology: Distorted or augmented reality?,” *Cuadernos Electronicos de Filosofia del Derecho*, no. 42, pp. 25–42, Jun. 2020. <https://doi.org/10.7203/CEFD.42.16386>
- [5] L. Chamba-Eras and J. Aguilar, “Augmented Reality in a Smart Classroom SaCI,” *Revista Iberoamericana de Tecnologías del Aprendizaje*, vol. 12, no. 4, 2018. <https://doi.org/10.1109/RITA.2017.2776419>
- [6] B. Shouman, A. A. E. Othman, and M. Marzouk, “Enhancing users involvement in architectural design using mobile augmented reality,” *Engineering, Construction and Architectural Management*, vol. 29, no. 6, pp. 2514–2534, Jun. 2022. <https://doi.org/10.1108/ECAM-02-2021-0124>
- [7] T. Miningrum, H. Tolle, and F. A. Bachtiar, “Augmented Reality Adapted Book (AREmotion) Design as Emotional Expression Recognition Media for Children with Autistic Spectrum Disorders (ASD),” *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 6, pp. 632–638, 2021. <https://doi.org/10.14569/IJACSA.2021.0120674>
- [8] G. Alkhanova, S. Zhuzbayev, I. Syrkin, and N. Kurmangaliyeva, “Intelligent Mobile Models and Their Application in the Educational Process,” *International Journal of Interactive Mobile Technologies*, vol. 16, no. 21, pp. 201–217, 2022. <https://doi.org/10.3991/ijim.v16i21.36069>
- [9] N. Vega-Lugo, R. Flores-jiménez, I. Flores-jiménez, B. Hurtado-vega, and J. S. Rodríguez-martínez, “Teorías del aprendizaje Theories of Learning,” *XICUA. Boletín científico de la Escuela Superior de Tlahuelipan*, vol. 14, no. 14, pp. 51–53, 2019. <https://doi.org/10.29057/xikua.v7i14.4359>
- [10] M. L. Picón, “¿Es posible la enseñanza virtual?,” pp. 11–34, 2020. <https://doi.org/10.29344/07180772.34.2357>
- [11] A. Papadakis, A. Barianos, M. Kalogiannakis, S. Papadakis, and N. Vidakis, “ARION: A Digital eLearning Educational Tool Library for Synchronization Composition & Orches-

- tration of Learning Session Data,” *Applied Sciences (Switzerland)*, vol. 12, no. 17, Sep. 2022. <https://doi.org/10.3390/app12178722>
- [12] M. Osnaya-Moreno and A. Llanes-Medina, “Favorable elements for the reading comprehension of texts in english in a virtual course,” *TECHNO Review. International Technology, Science and Society Review / Revista Internacional de Tecnología, Ciencia y Sociedad*, vol. 11, Dec. 2022. <https://doi.org/10.37467/revtechno.v11.4419>
- [13] S. Papadakis, “Robots and Robotics Kits for Early Childhood and First School Age,” *International Journal of Interactive Mobile Technologies*, vol. 14, no. 18, pp. 34–56, 2020. <https://doi.org/10.3991/ijim.v14i18.16631>
- [14] S. D. Druker Ibáñez, “PráCticas Letradas Y PráCtica Docente El Lugar De La ‘Escritura Libre’ En La Producción De Literacidad Escolar Con NiñAs Y NiñOs Quechua,” *Perfiles Educativos*, vol. 43, no. 171, pp. 44–62, Jan. 2020. <https://doi.org/10.22201/IISUE.24486167E.2021.171.59584>
- [15] S. E. Kalt and J. A. Geary, “Typological shift in bilinguals’ 11: Word order and case marking in two varieties of child quechua,” *Languages*, vol. 6, no. 1, 2021. <https://doi.org/10.3390/languages6010042>
- [16] D. Román, D. Masaquiza, K. Ward, and L. Gonzalez-Quizhpe, “Contextualización transformativa de Educación Intercultural Bilingüe: A migrant Indigenous Andean community in the Galapagos Islands,” 2022. <https://doi.org/10.1080/01434632.2022.2036167>
- [17] E. Alvarado-Causi, R. S. Bellido-García, A. Cruzata-Martínez, and J. Alhuay-Quispe, “Intercultural competences in primary school teachers’ under the urban context of Huaraz City, Peru: an ethnographic and educational analysis,” vol. 35, no. 2, pp. 176–193, 2020. <https://doi.org/10.1080/09518398.2020.1797209>
- [18] N. Limerick, “Attaining Multicultural Citizenship through Indigenous-Language Instruction: Successful Kichwa Misfires and the Modeling of Modernist Language Ideologies in Ecuador,” *Journal of Linguistic Anthropology*, vol. 28, no. 3, pp. 313–331, Dec. 2018. <https://doi.org/10.1111/jola.12195>
- [19] O. Cárdenas-Crisóstomo, “Intercultural education of the quechua language in the students of a public educational,” vol. 7, no. 1, pp. 55–60, 2021. <https://doi.org/10.46276/rifce.v7i1.1161>
- [20] X. Deng and Z. Yu, “A Systematic Review of Machine-Translation-Assisted Language Learning for Sustainable Education,” *Sustainability 2022, Vol. 14, Page 7598*, vol. 14, no. 13, p. 7598, Jun. 2022. <https://doi.org/10.3390/SU14137598>
- [21] H. Kubra and J. Lee, “Immersive Learning Technologies in English Language Teaching: A Systematic Review,” *Educational Technology International*, vol. 21, no. 2, pp. 155–191, 2020. <https://doi.org/10.23095/ETI.2020.21.2.155>
- [22] L. A. Valdiviezo, “Indigenous worldviews in intercultural education: teachers’ construction of interculturalism in a bilingual Quechua–Spanish program,” vol. 21, no. 1, pp. 27–39, Feb. 2010. <https://doi.org/10.1080/14675980903491866>
- [23] M. Cassels and C. Farr, “Mobile applications for Indigenous language learning: L literature review and app survey.,” *Working Papers of the Linguistics Circle of the University of Victoria*, vol. 29, no. 1, pp. 1–24, 2019. <https://doi.org/10.1920-440/102019-091014>
- [24] S. A. Booton, A. Hodgkiss, and V. A. Murphy, “The impact of mobile application features on children’s language and literacy learning: a systematic review,” *Comput Assist Lang Learn*, 2021. <https://doi.org/10.1080/09588221.2021.1930057>
- [25] C. Oranç and A. C. Küntay, “Learning from the real and the virtual worlds: Educational use of augmented reality in early childhood,” *Int J Child Comput Interact*, vol. 21, pp. 104–111, Sep. 2019. <https://doi.org/10.1016/J.IJCCI.2019.06.002>

- [26] G. Lampropoulos, E. Keramopoulos, K. Diamantaras, and G. Evangelidis, “Augmented Reality and Gamification in Education: A Systematic Literature Review of Research, Applications, and Empirical Studies,” *Applied Sciences* 2022, Vol. 12, Page 6809, vol. 12, no. 13, p. 6809, Jul. 2022. <https://doi.org/10.3390/APP12136809>
- [27] V. Mikašytė and V. Drašutė, “The Latest Advances in Technology-Enhanced Language Learning: An Overview of Studies on Vocabulary Acquisition,” *Conference.Pixel-Online.Net*, 2018, doi: ISBN: 8833590208.
- [28] R. Shadiev and M. Yang, “Review of Studies on Technology-Enhanced Language Learning and Teaching,” *Sustainability* 2020, Vol. 12, Page 524, vol. 12, no. 2, p. 524, Jan. 2020. <https://doi.org/10.3390/SU12020524>
- [29] H. Çetin, “A Systematic Review of Studies on Augmented Reality Based Applications in Primary Education,” *International Journal of Education and Literacy Studies*, vol. 10, no. 2, pp. 110–121, Apr. 2022. <https://doi.org/10.7575/AIAC.IJELS.V.10N.2P.110>
- [30] R. A. Liono, N. Amanda, A. Pratiwi, and A. A. S. Gunawan, “A Systematic Literature Review: Learning with Visual by The Help of Augmented Reality Helps Students Learn Better,” *Procedia Comput Sci*, vol. 179, pp. 144–152, Jan. 2021. <https://doi.org/10.1016/J.PROCS.2020.12.019>
- [31] A. E. Yastibaş, M. H. Baturay, and C. A. Çinar, “Augmented Reality-Based Digital Storytelling in Language Teaching and Learning: A Suggested Lesson Plan,” <https://services.igi-global.com/resolvedoi/resolve.aspx?doi=10.4018/978-1-7998-8981-6.ch003>, pp. 42–65, Jan. 2022. <https://doi.org/10.4018/978-1-7998-8981-6.CH003>
- [32] X. Huang, D. Zou, G. Cheng, and H. Xie, “A Systematic Review of AR and VR Enhanced Language Learning,” *Sustainability* 2021, Vol. 13, Page 4639, vol. 13, no. 9, p. 4639, Apr. 2021. <https://doi.org/10.3390/SU13094639>
- [33] N. I. Osman, S. Nazleen, and A. Rabu, “Digital Game-Based Language Learning: A Review of Research Trends on Second Language Acquisition,” vol. 13, pp. 56–62, 2020. <https://doi.org/10.5662/researchgate/340386978>
- [34] T. H. Laine, “Mobile Educational Augmented Reality Games: A Systematic Literature Review and Two Case Studies,” *Computers* 2018, Vol. 7, Page 19, vol. 7, no. 1, p. 19, Mar. 2018. <https://doi.org/10.3390/COMPUTERS7010019>
- [35] T. Redep and G. Hajdin, “Use of Augmented Reality with Game Elements in Education – Literature Review,” *Journal of Information and Organizational Sciences*, vol. 45, no. 2, pp. 473–494, Dec. 2021. <https://doi.org/10.31341/JIOS.45.2.7>
- [36] M. Sirshar, H. S. Baig, and S. H. Ali, “A Systematic Literature Review of Research Methodologies Used for Evaluation of Augmented Reality Based Learning Applications,” Dec. 2019. <https://doi.org/10.20944/PREPRINTS201912.0065.V1>
- [37] N. Raju and V. P. Joshith, “Augmented Reality in English Language Pedagogy: An Innovative Techno Culture for Contemporary Classrooms-A Meta Review,” *International Journal of Advanced Science and Technology*, vol. 29, no. 03, pp. 5957–5968, 2020. <https://doi.org/10.29032020/5957-5968>
- [38] J. Garzón and J. Acevedo, “Meta-analysis of the impact of Augmented Reality on students’ learning gains,” *Educ Res Rev*, vol. 27, pp. 244–260, Jun. 2019. <https://doi.org/10.1016/J.EDUREV.2019.04.001>
- [39] C. Gökhan Karacan and A. Professor, “Educational Augmented Reality Technology for Language Learning and Teaching: A Comprehensive Review Kemal Akoğlu,” 2021. <https://doi.org/10.34293/education.v9i2.3715>
- [40] K. C. Li and B. T. M. Wong, “A literature review of augmented reality, virtual reality, and mixed reality in language learning,” *International Journal of Mobile Learning and Organisation*, vol. 15, no. 2, pp. 164–178, 2021. <https://doi.org/10.1504/IJMLO.2021.114516>

- [41] A. Parmaxi and A. A. Demetriou, “Augmented reality in language learning: A state-of-the-art review of 2014–2019,” *J Comput Assist Learn*, vol. 36, no. 6, pp. 861–875, Dec. 2020. <https://doi.org/10.1111/JCAL.12486>
- [42] Q. Sarmiento *et al.*, “Análisis de las características de la Realidad Aumentada aplicada a la educación,” *revistas.uap.edu.pe*, 2021. <https://doi.org/10.21503/hamu.v7i3.2202>
- [43] B. Redondo, R. Cózar-Gutiérrez, J. A. González-Calero, and R. Sánchez Ruiz, “Integration of Augmented Reality in the Teaching of English as a Foreign Language in Early Childhood Education,” *Early Child Educ J*, vol. 48, no. 2, pp. 147–155, Mar. 2020. <https://doi.org/10.1007/S10643-019-00999-5>
- [44] E. Campos-Pajuelo, L. Vargas-Hernandez, F. Sierra-Liñan, L. Liñan, J. Zapata-Paulini, and M. Cabanillas-Carbonell, “Learning the chemical elements through an augmented reality application for elementary school children,” *Advances in Mobile Learning Educational Research*, vol. 2, no. 2, pp. 493–501, Sep. 2022. <https://doi.org/10.25082/AMLER.2022.02.018>
- [45] S. A. H. Morales, L. Andrade-Arenas, A. Delgado, and E. L. Huamani, “Augmented Reality: Prototype for the Teaching-Learning Process in Peru,” *International Journal of Advanced Computer Science and Applications*, vol. 13, no. 1, pp. 806–815, 2022. <https://doi.org/10.14569/IJACSA.2022.0130194>
- [46] J. C. Meniado, “Technology in English Language Teaching and Learning: An Interview with Professor Greg Kessler,” *RELC Journal*, vol. 53, no. 1, pp. 276–280, Apr. 2022. <https://doi.org/10.1177/00336882221081892>
- [47] S. Beltozar-Clemente, F. Sierra-Liñan, J. Zapata-Paulini, and M. Cabanillas-Carbonell, “Augmented reality mobile application to improve the astronomy teaching-learning process,” *Advances in Mobile Learning Educational Research*, vol. 2, no. 2, pp. 464–474, Sep. 2022. <https://doi.org/10.25082/AMLER.2022.02.015>
- [48] J. A. Holguin-Alvarez, C. Villa-Morocho, M. Montalvo-Callirgos, M. Villena-Guerreo, Y. Carrasco-Nuñez, and L. Espinola-Ayala, “Significado del aprendizaje–enseñanza de la matemática en contextos lingüísticos del quechua y ciudadanos,” *Investigación Valdizana*, vol. 13, no. 3, pp. 143–155, Jul. 2019. <https://doi.org/10.33554/RIV.13.3.343>
- [49] I. V. Dukalskaya and I. N. Tabueva, “Promoting Augmented Reality Technology in Teaching English Language to Non-Linguistic Students in Higher Education,” *European Journal of Contemporary Education*, vol. 11, no. 1, pp. 47–58, 2022. <https://doi.org/10.13187/ejced.2022.1.47>
- [50] A. TAKKAÇ TULGAR, R. M. YILMAZ, and F. B. TOPU, “Research Trends on the Use of Augmented Reality Technology in Teaching English as a Foreign Language,” *Participatory Educational Research*, vol. 9, no. 5, pp. 76–104, Sep. 2022. <https://doi.org/10.17275/per.22.105.9.5>
- [51] C. A. Huertas-Abril, J. F. Figueroa-Flores, M. E. Gómez-Parra, E. Rosa-Dávila, and L. F. Huffman, “Augmented reality for esl/efl and bilingual education: An international comparison,” *Educacion XXI*, vol. 24, no. 2, pp. 189–208, 2021. <https://doi.org/10.5944/educxx1.28103>
- [52] J. Wang and B. Gao, “The new trend of wearable technology in college foreign language classroom and its impact on college English teaching,” *International Journal of Electrical Engineering and Education*, 2021. <https://doi.org/10.1177/00207209211003210>
- [53] A. Larchen Costuchen, S. Darling, and C. Uytman, “Augmented reality and visuospatial bootstrapping for second-language vocabulary recall,” *Innovation in Language Learning and Teaching*, vol. 15, no. 4, pp. 352–363, 2021. <https://doi.org/10.1080/17501229.2020.1806848>

- [54] D. Rapti, D. Gerogiannis, and S. G. Soulis, “The effectiveness of augmented reality for English vocabulary instruction of Greek students with intellectual disability,” *Eur J Spec Needs Educ*, 2022. <https://doi.org/10.1080/08856257.2022.2045816>
- [55] S. Mozaffari and H. R. Hamidi, “Impacts of augmented reality on foreign language teaching: a case study of Persian language,” *Multimed Tools Appl*, 2022. <https://doi.org/10.1007/s11042-022-13370-5>
- [56] S. Zhang, “Integrating Augmented Reality into a Task-Based Thematic Language Teaching Unit,” *Journal of Technology and Chinese Language Teaching*, vol. 12, no. 2, pp. 29–48, Dec. 2021. <https://doi.org/20.500.12876/dvmq3R5v>
- [57] N. A. Sergeeva, A. N. Zakharova, O. S. Rublyova, and S. I. Tyutyunnik, “Features of using methods and means of the augmented reality technology when teaching a foreign language,” *Perspektivy Nauki i Obrazovania*, vol. 50, no. 2, pp. 472–486, 2021. <https://doi.org/10.32744/PSE.2021.2.33>
- [58] S. Amelina, R. Tarasenko, S. Semerikov, and Y. Kazhan, “Teaching Foreign Language Professional Communication using Augmented Reality Elements,” pp. 714–725, 2022. <https://doi.org/10.5220/0010927700003364>
- [59] M. Moral and E. Fuentes, “Robótica, realidad aumentada y TAC como herramientas clave en la metodología CLIL en Educación Infantil,” *academia.edu*, 2021. <https://doi.org/10.24310/mgnmar.v2i2.10908>
- [60] C. Gu *et al.*, “Effects of AR Picture Books on German Teaching in Universities,” *J Intell*, vol. 10, no. 1, Mar. 2022. <https://doi.org/10.3390/JINTELLIGENCE10010013>
- [61] J. Lee, “Problem-based gaming via an augmented reality mobile game and a printed game in foreign language education,” *Educ Inf Technol (Dordr)*, vol. 27, no. 1, pp. 743–771, Jan. 2022. <https://doi.org/10.1007/s10639-020-10391-1>
- [62] A. Taskiran, “The effect of augmented reality games on English as foreign language motivation,” *E-Learning and Digital Media*, vol. 16, no. 2, pp. 122–135, Mar. 2019. <https://doi.org/10.1177/2042753018817541>
- [63] W. Wu, Y. T. Yu, M. Ashar, T. I. Kuncoroaji, and V. E. B. Darmawan, “Applying Augmented Reality to Chinese Radicals Learning: A Remedial Teaching Experiment in an Elementary School,” *International Journal of Interactive Mobile Technologies*, vol. 16, no. 5, pp. 81–90, 2022. <https://doi.org/10.3991/ijim.v16i05.28983>
- [64] J. Palazón-Herrera and A. Soria-Vílchez, “Students’ perception and academic performance in a flipped classroom model within Early Childhood Education Degree,” *Heliyon*, vol. 7, no. 4, p. e06702, Apr. 2021. <https://doi.org/10.1016/j.heliyon.2021.e06702>
- [65] C. Montellanos, J. Luis, M. Vásquez, carlos, H. Salazar, and J. Luis, “Aplicación móvil de realidad aumentada y su influencia en el aprendizaje del idioma quechua,” *Conferencia Internacional de Investigación de Ciencias y Humanidades IEEE 2019 (SHIRCON)*, 2019. <https://doi.org/10.1109/SHIRCON48091.2019.9024860>
- [66] J. E. Zapata-Paulini, M. M. Soto-Córdoba, and U. L. Asto, “A Mobile Application with Augmented Reality for the Learning of the Quechua Language in Pre-School Children,” *Convención de Centroamérica y Panamá (CONCAPAN XXXIX)*, 2019. <https://doi.org/10.1109/CONCAPANXXXIX47272.2019.8976924>
- [67] E. Gutiérrez Gómez, I. Ocampo Yahuarcani, K. D. Jeri Lagos, and L. A. Saravia Llaja, “Warma: aplicativo móvil para el aprendizaje de matemáticas y lenguaje en instituciones educativas de las comunidades quechua hablantes en Ayacucho,” *Puriq*, vol. 1, no. 01, pp. 68–82, Dec. 2019. <https://doi.org/10.37073/PURIQ.1.01.57>
- [68] R. M. Yilmaz, F. B. Topu, and A. Takkaç Tulgar, “An examination of vocabulary learning and retention levels of pre-school children using augmented reality technology in English

- language learning.” *Educ Inf Technol (Dordr)*, vol. 27, no. 5, pp. 6989–7017, Jun. 2022. <https://doi.org/10.1007/s10639-022-10916-w>
- [69] S. C. Tsai, “Learning With Mobile Augmented Reality- and Automatic Speech Recognition-Based Materials for English Listening and Speaking Skills: Effectiveness and Perceptions of Non-English Major English as a Foreign Language Students,” *Journal of Educational Computing Research*, 2022. <https://doi.org/10.1177/07356331221111203>
- [70] I. Jalaluddin, R. Darmi, and L. Ismail, “Application of Mobile Augmented Visual Reality (MAVR) for Vocabulary Learning in the ESL Classroom,” *Asian Journal of University Education*, vol. 17, no. 3, pp. 162–173, Jul. 2021. <https://doi.org/10.24191/ajue.v17i3.14507>
- [71] H. Won. Ji, Hyang Eun & Shin, “Young Foreign Language Learners’ Engagement and Motivation in Augmented Reality-based Vocabulary Learning * I. INTRODUCTION,” *Multimedia-Assisted Language Learning*, vol. 22, no. 3, pp. 9–31, 2019. <https://doi.org/10.15702/mall.2019.22.3.9>
- [72] M. Bagherpur, K. Vakili, T. Emami, and S. Eimery, “The Impact of Training by Augmented Reality Technology on Creative Thinking and English-Language Learning Motivation of Students,” *International Journal of Early Childhood Special Education*, vol. 13, no. 2, pp. 1230–1237, 2021. <https://doi.org/10.9756/INT-JECSE/V13I2.211170>
- [73] Z. Syarifudin and Suharjito, “Mobile based for basic English learning assessment with augmented reality,” *Advances in Science, Technology and Engineering Systems*, vol. 5, no. 2, pp. 774–780, Apr. 2020. <https://doi.org/10.25046/aj050297>
- [74] X. Geng and M. Yamada, “An augmented reality learning system for Japanese compound verbs: study of learning performance and cognitive load,” *Smart Learning Environments*, vol. 7, no. 1, Dec. 2020. <https://doi.org/10.1186/s40561-020-00137-4>
- [75] C. Duée and J. Martin, “Immersive learning of French as a foreign language: Potential of applications and edutainment scenario,” *Anales de Filologia Francesa*, no. 29, pp. 183–199, 2021. <https://doi.org/10.6018/ANALESFF.483991>
- [76] B. Peña-Acuña and A. M. Martínez-Sala, “Augmented Reality stories for language learning,” *Porta Linguarum*, vol. 2022, no. 37, pp. 291–306, Jan. 2022. <https://doi.org/10.30827/portalin.vi37.20938>
- [77] N. A. Suwadi *et al.*, “Expert Review on Mobile Augmented Reality Applications for Language Learning,” *International Journal of Advanced Computer Science and Applications*, vol. 12, no. 10, pp. 339–347, 2021. <https://doi.org/10.14569/IJACSA.2021.0121037>
- [78] B. Acuña, ... A. S.-: revista internacional de didáctica de, and undefined 2022, “Cuentos de Realidad Aumentada para el aprendizaje de la lengua,” *dialnet.unirioja.es*, 2022. <https://doi.org/10.30827/portalin.vi37.20938>
- [79] L. Hu, Y. Yuan, Q. Chen, X. Kang, and Y. Zhu, “The Practice and Application of AR Games to Assist Children’s English Pronunciation Teaching,” *Occup Ther Int*, vol. 2022, 2022. <https://doi.org/10.1155/2022/3966740>
- [80] T. Leinonen, J. Brinck, H. Vartiainen, and N. Sawhney, “Augmented reality sandboxes: children’s play and storytelling with mirror worlds,” *Digital Creativity*, vol. 32, no. 1, pp. 38–55, 2021. <https://doi.org/10.1080/14626268.2020.1868535>
- [81] A. Herrero *et al.*, “Un proyecto de realidad aumentada en el aula de inglés,” *revistas.ucr.ac.cr*, no. 42, p. 2021, 2021. <https://doi.org/10.15517/re.v0i42.47179>
- [82] N. J. van Eck and L. Waltman, “Software survey: VOSviewer, a computer program for bibliometric mapping,” *Scientometrics*, vol. 84, no. 2, pp. 523–538, 2010. <https://doi.org/10.1007/s11192-009-0146-3>

9 Authors

Jhonatan Cardenas-Valdivia Computer science student at the Universidad Autonoma del Peru. He works as a developer of web and mobile applications, with knowledge in augmented reality, open source software, artificial intelligence, and business intelligence. He can be contacted at jcardenasva@autonoma.edu.pe.

Jean Flores-Alvines Computer science student at the Universidad Autonoma del Peru. With knowledge of Microsoft Office, MySQL database, HTML5, Figma, Github, Eco 3D, JavaScript, React, and WordPress. He can be contacted at jfloresal@autonoma.edu.pe.

Orlando Iparraguirre-Villanueva Systems Engineer with a master's degree in Information Technology Management, PhD in Systems Engineering from Universidad Nacional Federico Villarreal-Peru. ITIL® Foundation Certificate in IT Service, Specialization in Business Continuity Management, Scrum Fundamentals Certification (SFC). National and international speaker/panelist (Panama, Colombia, Ecuador, Venezuela, Mexico) (email: oiiparraguirre@ieee.org).

Michael Cabanillas-Carbonell Systems Engineer. A qualified researcher by the National Council of Science, Technology, and Innovation - Peru. Research professor at the Universidad Privada Norbert Wiener. President of the IEEE-Peru Education Society Chapter. President of the EIRCON Conference (Engineering International Research Conference) (email: mcabanillas@ieee.org).

Article submitted 2023-01-02. Resubmitted 2023-01-30. Final acceptance 2023-01-30. Final version published as submitted by the authors.