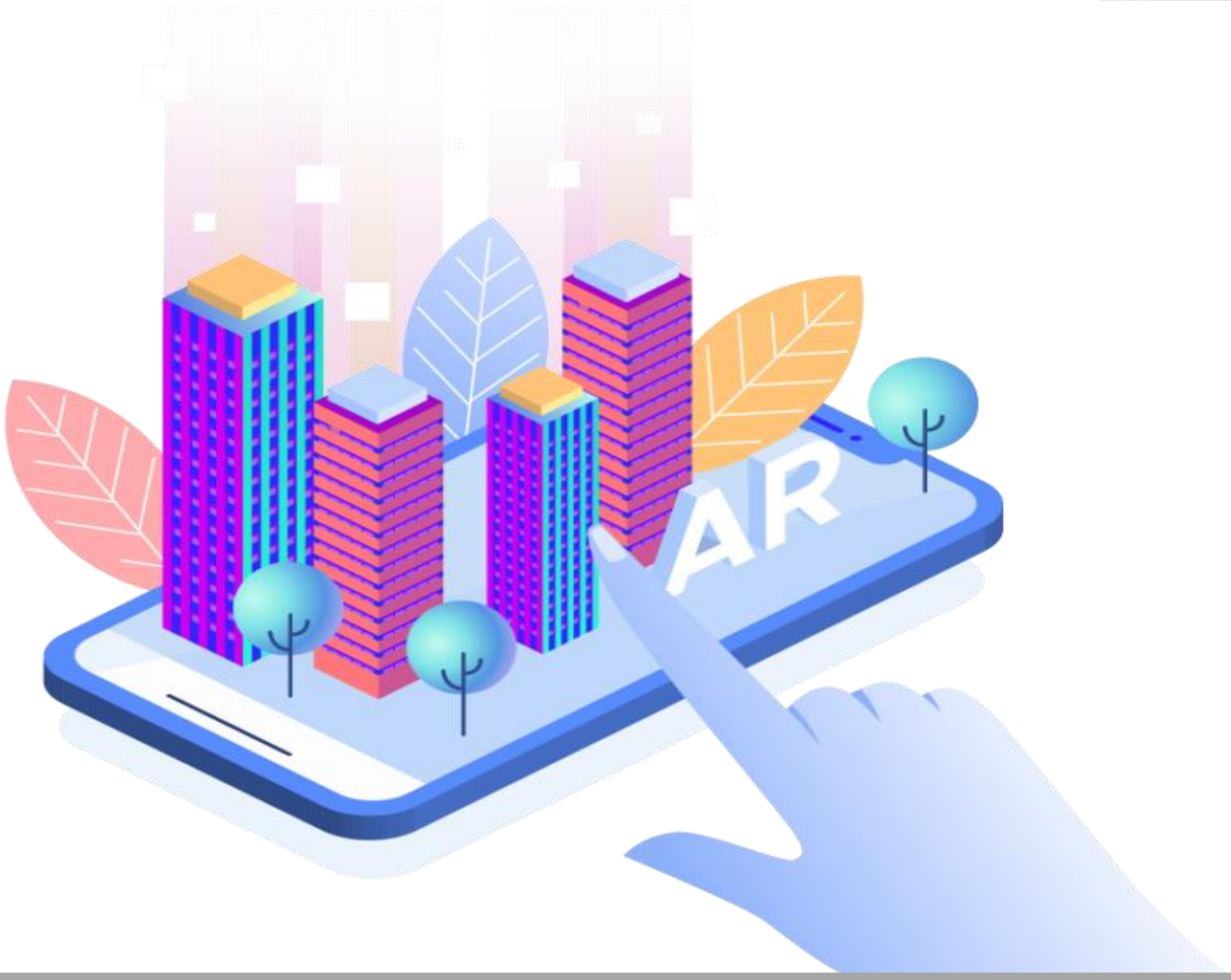

Comparing traditional approaches and augmented reality in language acquisition

A Literature Review

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ANNEX 47

1. Introduction

Augmented Reality (AR) goes a step further than VR, attempting to simulate reality, by adding digital images and data to supplement the view of the real world, thus giving users more information about their environments. With the widespread utilization of smartphones and tablets, with their crisp screens and built-in cameras and motion sensors, AR apps are bound to grow exponentially in both consumer and industrial applications (Jupiter Research predicts that AR will grow tenfold by 2019, to $2.4 billion in revenue). After the great success of Pokémon Go, tech giants', Apple and Google, next battleground is forming around AR, spending heavily to provide new applications. Apple will do so by using its specialized AR systems ARKit and Google its own ARCore. Neither Apple nor Google spend huge amounts of money for the sake of technology. Instead, they aim at both providing extra value for their smartphone users and increasing sales as well as creating new interesting applications. For instance, IKEA considers ARKit as an ideal way to estimate the size of virtual furniture placed in a room with an almost perfect accuracy, even though the iPhone and iPad are not equipped with any special sensors. No doubt, there will be many additional applications in the future.

AR technology can be classified into 3 categories: geographical positioning, objects positioned over reality, and interactive AR applications. The most common areas AR is being used are the military, medical and health, tourism and travel, marketing and sales, public services, games, social interaction, industrial uses, education and culture. (Cepeda-Galvis, 2018).

Regarding the integration of AR to education in today's world, we need to take into account the fact that young children/students nowadays are growing up in a multimedia world and integrating with the technology as part of the digital native or digital generation; Therefore, it is possible to assume that because of the rich content available in the training-education environment, they may easily lose interest and motivation with regard to traditional lessons. In this regard it is estimated that AR applications will have a different role to play during the process of achieving desired behaviors in the teaching and learning process, involving the placing of different point of views on the subjects and helping to inculcate positive attitudes to lessons that will lead to an increase in interest and motivation.

2. Objective, Aims, and Report Analysis

2.1. Objective

The current document aims to map the best practices in the partner countries of the AR4EFL consortium, related to the use of augmented reality in language acquisition. The main tools used are online desk research and field research in the form of surveys (via online questionnaires).

2.2. Aims

The target users to:

- become aware of the needs of EFL teachers and students
- discover the local situation (expectations /needs) of all partner countries as it is documented nowadays
- identify best practices used to teach English or other foreign languages with AR

2.3. Role of Analysis Report

The Analysis Report aims to:

- Provide an overview of how AR can contribute to the education field

- Include useful recommendations to guide the methodological implementation of the project product

- Provide a clear understanding of the context and situation of the use of AR in education and EFL in particular

- Identify patterns and common obstacles, opportunities, and needs at European and national levels.

3. Augmented Reality (AR) in EFL education and/or education in general

3.1 National Level

3.1.1. Greece

What are the needs of EFL teachers and students?

Despite language education being a decades-old endeavour, there still remain a lot of needs that both teachers and students have that are not addressed. Language teachers face the challenge of being able to teach vocabulary and grammatical concepts while keeping up with the changing, often rapid, technological advancements in the world of learning. Students, on the other hand, are challenged by their ability to quickly learn and retain new information, as well as how to use it in the real world. This means that they need to be able to learn via digital resources and have the capacity to adapt and change. All these needs require teachers to have a combination of skills. They need to have a deep understanding of the language they are teaching, but also be able to communicate with high-level efficiency to a demographic (young students) that can be easily distracted.

Particularly in Greece, education is a field that has been historically underfunded in Greece, even when compared to other European countries. The country's education system has been underfunded for years, with the result that the education of Greek youth has been affected to a significant degree. This has been the case for many, many years.

The quality of education, particularly teachers' capacity to encourage and promote such learning, is widely considered to be the most effective route to increased student learning outcomes. Therefore, EFL teachers must consistently be able to give a high-quality education to their students.

So, as you can see, there are many challenges. These challenges are not going to become simple once a solution is found. This is why it is important to work on solutions to problems. And technology, as it has done before, could offer solutions to problems such as this one.

The use of AR in EFL learning

Augmented Reality is a type of technology that allows educational resources to be enhanced with additional information, graphics, videos, etc. This technology is becoming increasingly important within education and will likely continue to progress. For example, the use of augmented reality can help teachers to enhance the learning of students. The use of augmented reality can be used in two ways: it can be used to add new content to an existing lesson or to supplement an existing lesson in a new way. In addition, the use of augmented reality can make students feel more engaged in the learning process, and make them more likely to further interact with the material.

Through augmented reality, students can learn the content in a new way, for example, they can learn the content through an interactive experience, such as a game. This can make students more interested in the learning content.

However, EFL teachers in Greece have had no such training in AR themselves, as no significant amount of literature can be found on the subject in this country. It goes without saying that if the teachers themselves are not trained, then actually training students using AR tools is not practically feasible.

How can AR contribute to education?

Using AR in the classroom creates a unique opportunity for the EFL teacher to present the learning material in a way that is interactive and fun. Using AR in the classroom is a great way to engage your students and make the learning process more fun.

There is no need to have to spend a great deal of time preparing the lesson, instead, the teacher can use the time and resources to provide more valuable content to the students, and they can use the time to prepare for exams, assignments, or class projects.

The added benefit is that the teacher can use this application to keep their students interested in the learning material, and the students can use the AR application to enhance their learning as they can view the lesson, and use it to test themselves in the lesson.

That being said, due to the lack of experience and training of EFL teachers in Greece with the use of AR, the valuable contribution that this technology could have will remain hypothetical, unless a change is made.

Obstacles and challenges of AR in Greece

Given the established challenges in the country, the adoption of a new technology, such as Augmented Reality, is significantly more difficult than one would think. There are other areas where people would argue need to be emphasized first, with regards to the budget. This general lack of infrastructure in Greece makes it difficult for teachers to get equipment, such as smartphones or tablets. Teachers, in turn, cannot get these devices for their students. This means that students are not able to use Augmented Reality in their learning, as would be required in this case.

It is therefore very important to recognize the challenge that the adoption of new technology such as Augmented Reality presents, and the obstacles that the lack of infrastructure in Greece presents. However, if we look at the potential benefits that AR does offer, we can see that it would, in fact, be a boon to the education system.

That being said, sustainability is also an issue that needs to be taken into consideration. It is not enough for schools to be equipped with AR technology, they also need to be able to keep it up-to-date. If new advancements in AR appear, schools in Greece will have to be able to keep up, otherwise, they would face the same problems all over again.

Regardless, the use of Augmented Reality in education is a great way to keep students engaged. If teachers can set up an environment where students are learning through AR, they will enjoy learning more and will be eager to do so. If AR is used properly, it can help students learn at a level that will exceed that of traditional education by far. To that end, it is important to invest in this technology so that language teachers in Greece can use AR to teach their students, despite any obstacles they encounter.

In closing, we can see that Augmented Reality can be a boon to the education system in Greece because it would help students learn at a level that exceeds what they have been able to learn using traditional educational methods. It is a technology that will help students in many different ways and is a great way to retain students' attention, as well as (eventually) giving them a competitive advantage in the job market.

3.1.2. Cyprus

What are the needs of EFL teachers and students?

It is clear from the surveys contacted in Cyprus that school teachers have no experience in the use of AR, as an educational tool. Only a few teachers have experience in the use of AR in their personal life. The only exception is one teacher who has used AR to show the planets to children in a Geography lesson. No teacher had any experience in the use of AR in EFL.

Additionally, none of the teachers has any (formal or non-formal) training in the use of AR technology in education. Therefore, the majority do not feel confident in using it in the classroom. This finding corroborates with the literature [18], which indicates that the development pace of technology and innovative devices far exceeds the development pace of teachers integrating each technological innovation within the educational process, something which creates feelings of anxiety and insecurity. (Lasica, Mavrotheris and Katzis, 2020).

The use of AR in EFL learning

No research related to AR in EFL teaching specifically in Cyprus has been identified. One study related to AR in education in Cyprus was identified. The research presents a Teacher Professional Development (TPD) program, developed within the context of the EU project Enlivened Laboratories within STEM Education (EL-STEM), which aims to familiarize teachers with the potential of AR technology for enhancing the teaching and learning processes in lower secondary STEM education (Lasica, Mavrotheris and Katzis, 2020).

The research showed that AR has a positive effect on students' learning. Teachers highlighted positive aspects in their students' participation and motivation during the educational process. Characteristically, they mentioned that students who were typically paying little or no attention in class, worked efficiently with their classmates when AR was introduced, trying to solve the worksheets' exercises and in one case, even leading their team. According to the teachers, this was probably the first time that some of those students raised their hands to answer the teacher's questions. Moreover, teachers mentioned as a positive aspect the fact that students could repeat the projection of the AR object as many times as they wished, even outside the classroom, just by using their mobile phones with the relevant trigger images. Finally, some teachers noticed that some of their students could more easily recall the topics taught with AR (photographic memory), something which proved helpful in achieving higher scores in their

exams. Moreover, teachers mentioned that completing worksheets with activities relevant to the AR technology were motivating for students with lower performance to complete. Thus, their performance was surprisingly higher than expected, since those students usually submit "blank pages".

Obstacles or challenges

According to the same research, an important factor influencing the above-mentioned positive aspects and distracting students' attention and interest is the stability/reliability of the AR application used to view the educational content. The more issues students faced (e.g., too much effort to focus the mobile device on the AR object), the more they got distracted and stopped trying. Furthermore, from the teachers' point of view the most common obstacles mentioned in the AR4EFL surveys were "Lack of training", "dependence on hardware" and "technical problems". On the other hand, the research conducted by Lasica, Mavrotheris and Katzis (2020) revealed that teachers needed less time than expected to get familiarized with the applications/tools for developing AR educational content.

3.1.3. Finland

Use of AR in education in Finland

According to our desk research and survey among teachers, the use of VR and AR is quite low in terms of school education in Finland, and in education in general. VR and AR are used for different purposes, especially for entertainment (games), business (marketing, conferences) and technological applications, but much less in education (e.g. Hyttinen, 2020). There are some applications in teaching technology or health sciences in particular, but very few are used in language learning. There are plenty of applications that are available online or on smartphones for teachers to use, and some of the mobile applications are used more frequently, but most of the high-quality AR/VR software and hardware is quite expensive and requires more training from teachers.

Challenges

One of the biggest challenges according to researchers is still the high price of the VR/AR equipment or hardware, even though more affordable solutions are being developed all the time. Another challenge, according to Luusua, is the "wow" effect from VR – which refers to the experience virtual reality creates that the student has not experienced before and this might

sidetrack the learning process and decrease motivation regarding the content (Luusua 2018). Furthermore, the content of the games/applications can pose challenges – most games used in teaching focus on visualisation and not as much on the gamification aspect. VR games used in education are also often based on monologue and visualisation and textualisation of what is being taught, and they are not very interactive and do not allow the learner to proceed at their own pace, for example (Luusua 2018). There are traditional programmes with educational content on e.g. Steam platform for video games, but these games are limited in quality and features (Luusua 2018).

According to the surveys and our research, teachers are also worried about the skills and training needed for learning how to use AR and its applications in the classroom. It is difficult to find the time and resources for this in their already hectic schedule.

Opportunities

There are constantly changes and improvements in the development of VR and the prices of this technology are changing. Solutions such as Google Cardboard and Samsung Gear VR enable use of VR on mobile phones. There are new developers in the market and wider solutions on offer for VR. However, according to Luusua, the solutions are quite simple – either expensive solutions enabling the use of good software, or cheap and only enabling simple VR applications. (Luusua 2018)

In recent years, there have been many projects in Finland to try to enhance learning technologies and use of AR and other smart learning solutions. For example, in Finland five cities and three universities of applied sciences implemented a large project called “6Aika: Smart Learning Environments for the Future”, where they examined e.g. the use of AR in learning, though applied mainly to education in technology, health sciences, communication, instead of language teaching.

(https://www.oppimisenuusiaika.fi/en/oppimisen-uusi-aika/)

There are many AR and VR apps used by Finnish teachers for the purposes of language education, such as Merge Cube, Figment, AR flashcards, Metaverse, and applications by the Finnish company Arilyn, among others. These applications are mainly used to create interesting AR environments or to tell students’ own stories in a visually impressive and interesting format (Laakso, 2018). Teacher Matleena Laakso, for example, presents in her blog many different

applications and their uses in teaching – for example with Figment application, it is possible to bring different characters and effects to life on the screen and to create portals. This allows students to use AR in a more creative and personal way to create something instead of just playing a game – and also to share it with others (Laakso, 2018).

Survey Analysis

When conducting a questionnaire regarding the use of Augmented Reality among teachers in Finland, we had 9 respondents. Out of the respondents, 55.60 % had used AR to some extent, either in the classroom or for personal use, although none had used it for ESL/EFL or language teaching.

At least two of the respondents would like to try AR in teaching, if they had the opportunity. As benefits of using AR for ESL/EFL teaching, the respondents mentioned increased content understanding, Practical learning and Increased student motivation as benefits. As obstacles, 33 % mentioned lack of training of teachers, as well as the fact that it is not practical, and some also mentioned dependence on hardware as an obstacle.

In terms of the teachers' confidence in their skills in using AR and its applications in the classroom with students, most rated their skills and ability in this respect as high or average, even though most of them had not used them in language teaching. As to the usefulness of AR in ESL/EFL teaching, this was rated as average or low. When asked what more they would like to learn about AR, the answers were e.g. learning more good/ practical examples, and how it can be used in different learning situations.

In terms of their own experience in using AR, most did not have any. One teacher answered:

"We can bring lessons to life with several tools available online and students can use their own devices instead of books, most of the time."

In summary, among teachers in Finland there was little experience in using AR in language teaching, but there was a lot of interest in trying it, although also a lot of skepticism as the majority thought it might be too difficult, time-consuming and expensive.

3.1.4. United Kingdom

What are the needs of EFL teachers and students?

It is important to focus on vocabulary and language development of the students. By introducing concepts such as vocabulary, key words and pronunciation learners can improve their language learning and pronunciation. Visual aids can benefit student's language learning as they can begin to understand what new words mean. Another great way to help the language needs of ESL students is guided interactions. This can vary from guided reading, listening, speaking and writing. When doing guided reading, the teacher reads a section of a book and then will ask key questions to the students to see if they have understood well. It is a great way to work with the students and for the teacher to see the depth of understanding each student has. To add to the concept of visual learning, graphic organisers and modelling is also important. Visual learning is very important to all EFL students as it provides clues and visual cues to the language they are learning and helps them grasp concepts of the language they are learning. A classroom should have many visual aids to help the students understand better and they can then refer to the visuals around the classroom to help them.

Teachers model and teach thinking skills (metacognition) which is important when learning new concepts. Teachers must use various different ways to assess their students' learning and understanding.

EFL teachers have different needs to be met. Microteaching can be incredibly efficient when teaching language students as smaller groups of people at a time means the teacher can focus on fewer students therefore helping students on a 1 to 1 basis. Having a tighter group can mean the EFL learners have more feeling of success when learning which is important to the students as it can increase their learning success and motivation. However, some students prefer to be taught in groups as they can receive help and advice from their peers that will help them when learning.

The use of AR in EFL learning

A study was conducted to find out the efficiency of using AR in language teaching and the benefits it can have regarding the students. It has shown that many European countries have innovated their way of teaching by implementing the use of technology and educational trends. By doing so, the student learning performance could improve without adding to their workload or stress. By switching from books to digital media students can be taught in a variety of different ways that will suit them. According to Chang et al 2020, applying AR in educational contexts has

become increasingly popular as it provides the learner with a unique experience. This unique experience allows students to perceive the 'real-world' without leaving the classroom and understand concepts that would be hard to understand when using a 2D model (books). Hsu found that AR can teach 'ubiquitous' learning which can support students to achieve situational learning which can be effective in helping them reach their language learning goals. AR is also beneficial as it can help speed up reaction time when learning a language and aid students in being able to react to a conversation or take part in a conversation in real-time.

How can AR contribute to education?

Using AR in the classroom can help students learn class material faster as they are more immersed in the experience. The teacher is able to show virtual examples of the concepts they are teaching; therefore, the students will be able to understand better and memorise the information given. There are already some small instances of AR use in the classroom – for example the use of Google Expeditions. This was used in primary teaching to show children the different 3D objects around their classroom – such as volcanoes, storms etc. This app provided over 100 AR expeditions that could take the children anywhere in recorded history. Using this method of teaching is incredibly beneficial as it meant that children could see what they were learning about first-hand and retain it as the human memory doesn't forget visuals easily. The use of AR is also easy to access from anywhere which means students are able to work from home if necessary and still have received the same experience. AR is an innovative and engaging technology which will pique many students' interest and keep them motivated to learn more.

Obstacles or challenges

Research has found that the challenges of using AR for education are similar in most countries. There are some challenges that could be crucial to the implementation of using AR in education. For example, teacher training is a large portion of the challenges found. Using AR in education will mean that all teachers will need to be trained in the technology extensively. This would require more teacher training days, more technology in schools and more money spent. As of now, schools in the UK are not highly funded and would lack the funds to purchase AR equipment and lack the funds and time to train the teachers accordingly. This could mean that students on English courses may have to pay more for the experience as the schools themselves would not have the funds to support all the new technology. Following this, AR technology may not work on the current technology schools or students have, which means more money would need to be spent upgrading the school's technologies and software's which would of course, end up

costing the schools a lot more money than they have.

The use of AR in education would also mean dependability on the technology. This can be a challenge because if the school has a power cut, or the technology fails, they have no way to teach the content via AR. The dependence on technology could mean some days the students do not learn as efficiently as others.

Overall, the challenges faced when implementing AR in education could essentially outweigh the success of AR in education. The reason being, schools in the UK are already underfunded, meaning they would struggle to upgrade to AR technology. With regards to language schools, it could mean increasing the admission price to help fund the technology, which some students may not be able to afford. Although the technology carries many benefits, it is down to how it can be implemented without drastically increasing admission prices.

3.1.5. Spain

Use of AR in education in Spain

The use of ICT in education is booming, so much so that the Spanish Organic Law for the improvement of educational quality (LOMCE) devotes a competence to the use and management of new technologies. It is therefore essential to include augmented reality in education as it will help us to make teaching practice more dynamic and motivating.

At the non-university level, we can see important differences between children in infant, primary and secondary education. In infant education, for example, experiences of this type should be based above all on visual and auditory aspects, as at this stage the learning channels are mainly visual and auditory.

In primary education, a common education is provided in which all children achieve basic learning such as oral expression, reading, writing, foreign language, etc. The different uses of augmented reality that we can carry out at this stage will include various subjects, which is why it is necessary for the teacher to be competent in all areas at this level. To this end, the INTEF - Instituto Nacional de Tecnologías Educativas y de Formación del Profesorado (National Institute of Educational Technologies and Teacher Training) has been created as the unit of the Ministry of Education, Culture and Sport responsible for the integration of ICT in non-university educational stages. The objectives of INTEF are: Elaboration and dissemination of curricular materials and other support documents for teachers; training of teaching staff and scientific and didactic updating of teachers; Elaboration and dissemination of materials in digital and

audiovisual support in all areas of knowledge, with the aim of making information and communication technologies an ordinary working tool in the classroom; The implementation of training programmes for the application of ICT in the classroom.

However, AR/VR or Mixed Reality technologies are still unknown to teachers, especially how to apply them in the classroom. Some teachers who are more trained in ICT incorporate them in a marginal and motivating way when they find certain applications that they can adapt in their classes. They are not yet technologies that are widely used in schools.

What are the needs of EFL teachers and students?

Spain suffers from a historical backwardness in language skills: according to Eurostat, 46% of the population aged 25-64 could not speak any foreign language in 2016, a figure 10 points worse than the EU average. In English proficiency, the country is also at the bottom of Europe: according to the 2021 English Proficiency Index (EPI), an international ranking compiled by the Swedish language teaching company Education First, Spain ranks 25th in Europe. To fill this gap, the regional governments, in the public network, and the state-subsidised education system have multiplied the number of bilingual schools, the vast majority of them in English. The need to find sufficient staff has, however, led to the acceptance of teachers with an insufficient level of English (B-1 is sufficient in some autonomous regions) to teach the subject properly.

Some teachers use applications that are not specifically for foreign language learning, but are in English and, in this way, the foreign language competence is worked on at the same time.

In many secondary schools, the level of English with which pupils leave 6th grade from "bilingual" primary schools is lost. English language classes should always be taught by native speakers or teachers with at least a C2 level, with a degree from their country of origin or with a CELTA or TEFL/TESOL certificate. In addition, Student Talking Time should be increased, through role plays in class, work in pairs or small teams, with current topics that interest teenagers and allow them to use the language and not just learn grammar.

It is clear that Spain is not achieving the objective of implementing bilingualism in education, and this is basically due to the fact that it is impossible to innovate in learning. In order to implement bilingualism successfully, the methods and resources available to schools must be improved through educational innovation. Therefore, methods and activities where the predominant factor is speech are required. The aim is to promote speaking in English with the students.

The use of AR in EFL learning

Some studies already endorse this success using Augmented Reality in its use for learning the foreign language: English. At the primary school stage, it has been proven that this tool facilitates the development of classes and improves the acquisition of content by pupils (Bezares, 2020).

In the case of more global studies, which investigate how this technology has influenced education in general, the results indicate that "logical changes stand out, such as greater and different access to information, together with transcendent innovations, such as the increase in informal and playful activities, insertion in iconic virtual environments, belonging to specific groups and networks of friendly interaction within new scales of values" (Fombona et al, 2017).

On the other hand, articles such as the one by Márquez (2018), studies the relationship between educational games and AR and indicates how "the use of this technology improves the use of knowledge". Or Prendes (2015), who points out that "Augmented Reality is a promising technology (...), which can help to improve the teaching-learning process".

Obstacles or challenges

We could say that the studies carried out to date support the fact that the use of Augmented Reality can improve and enrich the learning process of students, making the contents more motivating and closer to them. Now, starting from this premise, the question that arises is the following: in which applications, pages or resources can we find this AR, to be able to use it in the classroom?

The first analysis to resolve this doubt is to study or define whether the technology is sufficiently mature and whether there is a variety of applications for its application. The answer is yes to both premises: the technology is evolving and is becoming more and more accessible and implemented in other sectors and it is possible to access applications free of charge and applications that allow you to generate your own content.

Another important element to highlight is the relationship between AR and its mastery and acceptance by teachers, since, together with the students, they are the ones who are going to work with this tool, and for this, training is essential. "It is undeniable that many of those in the profession have been trained with methodologies from the last century, which in the space of a few years have become obsolete and whose paradigms are difficult to break". Moreover, the characteristics of teachers, their preferences and learning abilities are not the same either, so we can find the same centre with very different classrooms in terms of technology, or similar

schools in terms of context, student body, etc. whose differences in methodologies are enormous.

The main obstacle is the digital divide that exists between different neighbourhoods in large cities and rural areas. Spanish schools depend on each Autonomous Community and the implementation of AR requires basic equipment. This leads to significant differences. However, actions are being carried out to equip the centres in an attempt to ensure that each pupil has a device (computer or tablet) at their disposal on a continuous basis.

3.1.6. European level

Augmented reality (AR) is a powerful new technology, growing in popularity in teaching and learning. What has yet to be well established is when and with which learners and learning tasks these technologies can be used as an effective approach.

There is an increased interest towards this field, however, due to the novelty of the technologies, research concerning augmented reality integration into teaching and learning is still relatively small in scale but with strong potentials (Ibáñez and Delgado-Kloos, 2018)

Some studies have identified specific factors that may affect the acceptance of AR technology in education, such as curriculum, stability of the interaction, self-learning capability, parents' involvement, students' background, platform, and social factors (Arvanitis et.al, 2009, Dalim et.al, 2017)

At the same time, despite the evidence that AR can be used as a powerful educational tool, many teachers remain unprepared to effectively employ technology-enhanced teaching practices, as changing teaching practices is proving difficult (McNair and Green, 2016)

A lot of teachers are reluctant to use new technologies for various reasons, such as:

(i) lack of confidence in their use;

(ii) lack of time or motivation for acquiring new technological skills and adapting new pedagogical strategies;

(iii) lack of existing educational resources;

(iv) the fact that they feel uncomfortable with student-centered approaches enhanced by new technologies (McNair and Green, 2016)

Moreover, the fast pace of technology and innovative devices development far exceeds the pace of research studies aiming to identify effective ways to integrate each technological innovation within the educational process. Therefore, teachers, as well as other stakeholders involved in education (educational researchers/designers/developers, decision makers, school administrations, etc.), face challenges in deploying innovative smart learning environments as they need to stay up-to-date with the latest developments in technologies and devices. For teachers to feel more motivated and take the time to learn those new skills needed in order to introduce innovative technologies in their classrooms, they need to realize their educational added value and potential benefits. It is crucial for both new and already practicing teachers to have opportunities for adequate training concerning the challenges of the twentieth-first century and the ways in which technology-enhanced learning can help learners cope with these challenges. They need to acquire knowledge relevant to emerging technologies in educational contexts, as well as develop skills in effectively applying these technologies (Lasica, Meletiou-Mavrotheris and Katzis, 2020).

Augmented reality in education

- Mobile AR and game-based learning were asserted to have a positive impact on English language teaching. With the affordability of powerful mobile devices, educational AR is considered one of the most impactful technologies in the next decade.

Augmented reality in Foreign Language Teaching

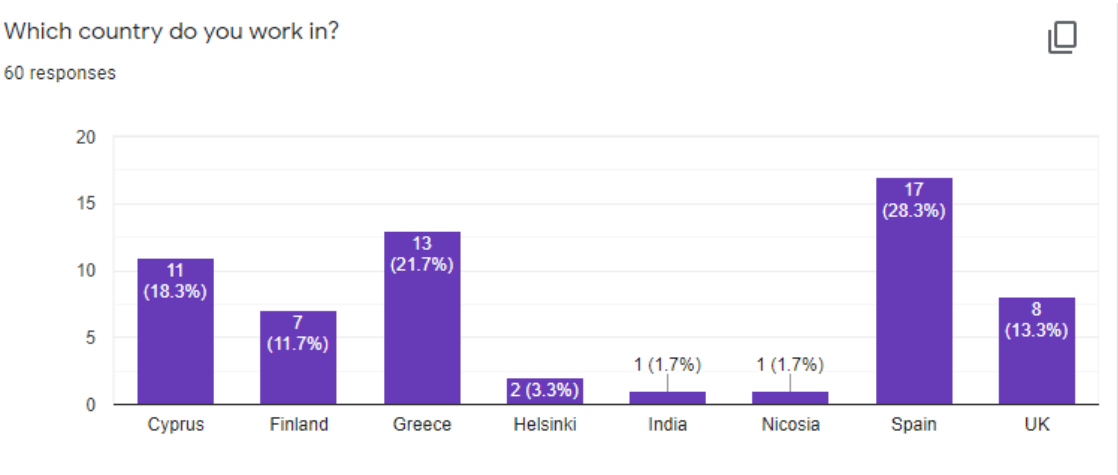
- A very limited number of AR applications and contents are available for language education. The mobile AR applications can be grouped into three depending on their purpose, place, use, and usability.

Imaged-based AR	Markerless AR	Creation-based
There are applications that work exclusively with sets of flashcards that can be bought at the physical stores or through online shopping sites to be delivered. Every single set of flashcards needs its application to be downloaded; however a single app can run a few sets of flashcards only if these flashcards belong to the same company.	These are ready-to-use applications available on the market that fit this category. In these applications, one can find ready materials for their lessons; however, it should be noted that these ready-made applications do not always fit teachers' learning objectives, and they are not always customizable to teachers' needs. Therefore, the ready creations available in such applications will need teachers' effective instructional use.	This type of AR application allows users to create their own customizable AR experiences. Through such applications, users can connect a picture to a video, music, 3D object or even a 360 video of their choice. The rationale behind choosing AR as an educational tool is its capacity to integrate context specific multimedia components and provide benefits for students' language and 21st century skills development. In that case, teachers can make use of these applications in which they can freely create their own contextual AR experiences. Serving that purpose, there are dozens of mobile available.

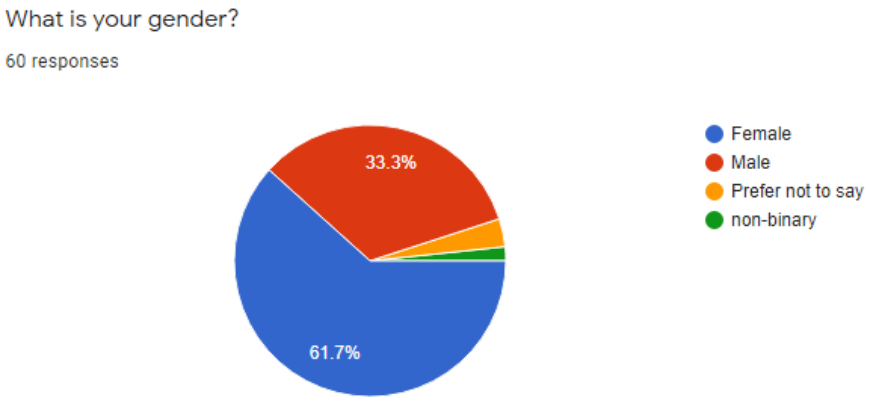
4. Research on AR in EFL and/or education in general at European level

4.1. Demographics

Our survey questionnaire (see annex) was distributed among all partner countries (Cyprus, Greece, Spain, Finland, UK). We received 60 responses in total.



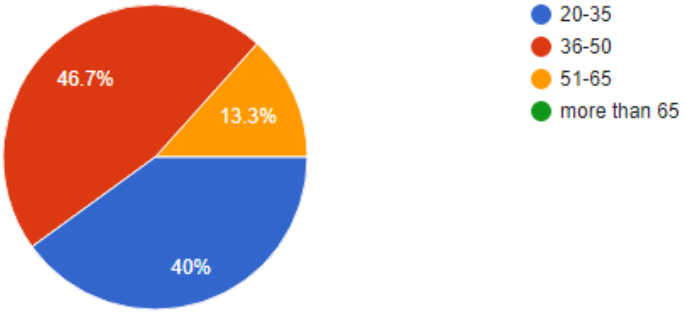
Out of the 60 respondents, the majority identify as females (61.7%), 33.3% as males and a small percentage as non-binary (1.7%). 2 respondents selected the “prefer not to say” option.



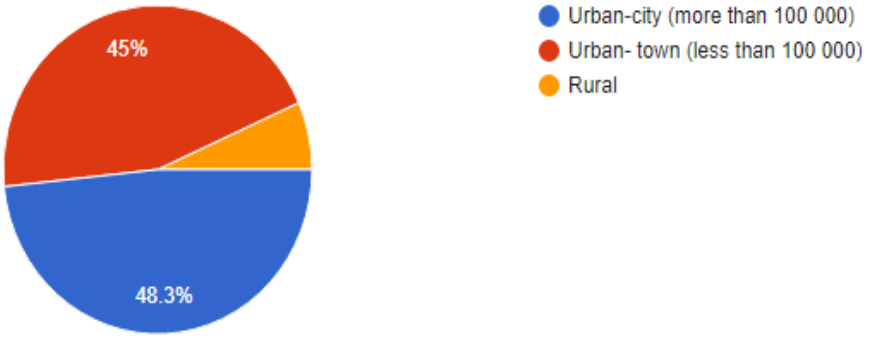
Most of the participants are aged between 20-35 and 35- 50. Only 13.3% were between 51-65 years old.

How old are you?

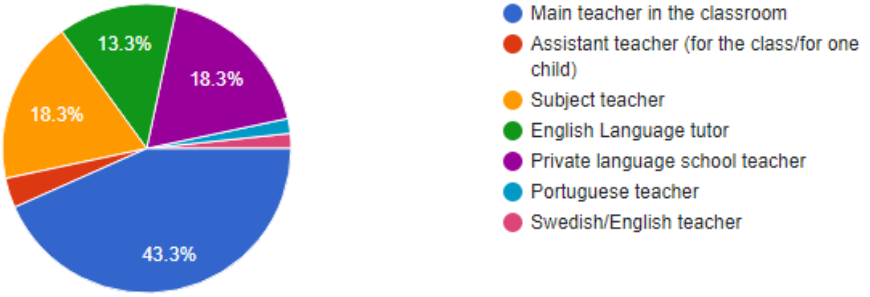
60 responses

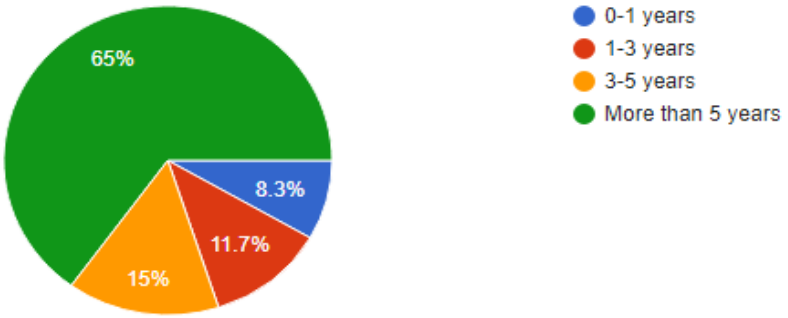


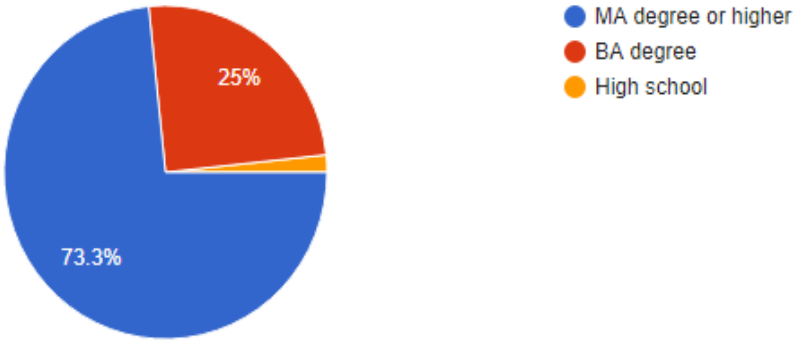
Only 6.7% stated that they live in a rural area. The remaining percentage live either in a big city or town.



The majority of the respondents are teachers in public schools but there was also a small percentage of private tutors (13.3%) or private language school teachers (18.3%). 65% of the respondents have more than 5 years' experience in their field, and the vast majority hold a master's degree (73.3%).

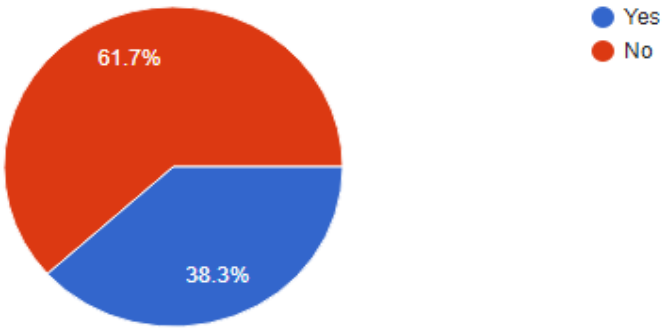




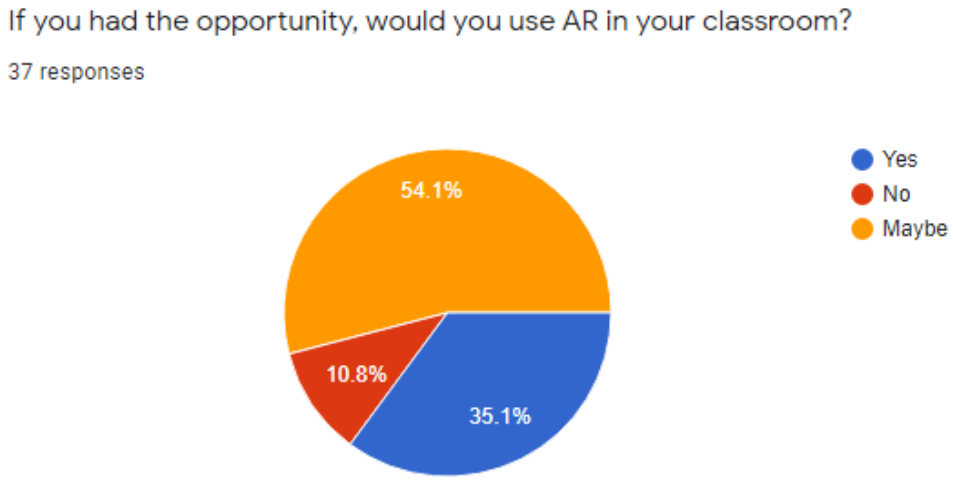


4.2. Use of AR in the classroom

The majority of respondents have never used AR (61.7%), either in the classroom or in-person



More than half of the participants would like to use the AR technology in their lesson.



When asked about the benefits of using the AR technology in EFL teaching, the most popular answers were:

1. Increased student motivation 67.6%
2. Increased content understanding 48.6%
3. Practical learning 48.6%
4. Long-term memory retention 37.8%
5. Improved collaboration 29.7%
6. Learning language associations 27%
7. No special equipment is required 10.8%

The main obstacles were “lack of training” (78.4%) and the dependence on hardware (51.4%)

4.3. AR experience

When asked more specifically about their experience with AR in ESL/EFL, only 24% have stated that they have relevant experience. Some participants with relevant experience have stated the following:

"I use some augmented reality applications in English for my students, with a tablet it is possible to motivate them.For example: ZooBurst, Fetch! zookazam, Cyberchase 3D".

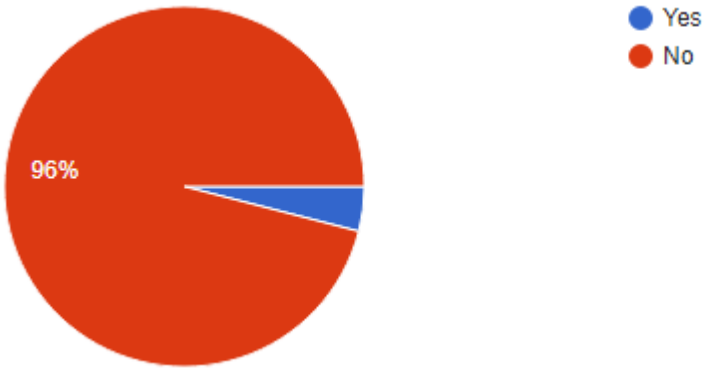
"Rarely when I can use it for an exercise, like giving directions using GPS"

"Books with sounds"

"I used it for vocabulary learning in preA1/A1/A2 levels ('iwonder' by Express Publishing)"

The vast majority of them stating that the use of AR increases student motivation (92%).

Surprisingly, only 1 respondent out of the 60 has stated that they have received training in the use of AR. The training was a 100 hour course in AR in Education, and was privately funded.



Overall, the majority of respondents did not feel confident at all or felt somewhat confident to use AR in education but most of them agreed that AR can be a useful tool and improve students' participation.

The participants were then asked what they want to learn in relation to AR technology. Responses varied from basic knowledge (i.e "*How to use it", "Step by step processes", "available ready-made material to use", "special equipment needed", "availability of existing learning materials"*, to more specific requests such as *"Learning how it could be used in different types of*

learning situations or for different skills (not just vocabulary)", or "How to use it more creatively, not just as a gimmick but something that really inspires students".

When participants were asked to describe how they have used AR in the classroom, most respondents said they have used an app to teach vocabulary, to present/show something or as a tool/game to motivate and reward children. One respondent stated *"we can bring lessons to life with several tools available online and students can use their own devices instead of books, most of the time".*

Other than that, the respondents only mentioned museums and gaming as examples of other applications of AR.

Finally, when asked what they would like to see in an AR application, answers included *"Some content that will improve students' collaboration and that could increase students' motivation", "an application that can be used at school", "combination of audio and visual content", "Multicultural and inclusive space with interactive games and music", "Representations of scenes", "representations of objects that children cannot easily see"*

5. Best practices regarding the use of AR in education

Cyprus		
Best practices	**Description**	**Link**
ENTERCY Augmented Reality And Storytelling Mobile App	Interactive Digital Content For 100+ Of The Most Important Tourist Sites In Cyprus 200+ tourist sites with Digital Content 100+ narrations and audio guides 50+ 360o Virtual Reality Explorations 20+ Reconstructions of archaeological sites, monuments, and artifacts. The experience is enhanced with innovative augmentations of Cultural Heritage sites	https://www.entercyprus.com
Planets Augmented Reality	The aim is for students to learn about the planets of our Solar System using the zappar application and to describe them. They are also asked to find a solution to a problem where they will need to record metrics given by the table application, make number comparisons and make a decision about the problem. Relevant worksheets and evaluation sheets are given.	http://photodentro.pi.ac.cy/ugc/r/8544/2078

SCHEDAR – Safeguarding the Cultural HEritage of Dance through Augmented Reality	SCHEDAR will provide novel solutions to the three key challenges of archiving, reusing and repurposing, and ultimately disseminating Intangible Cultural Heritage (ICH) motion data. In addition, we will devise a comprehensive set of new guidelines, a framework and software tools for leveraging existing ICH motion databases. Data acquisition will be undertaken holistically; encompassing data related to the performance, the performer, the kind of the dance, the hidden/untold story, etc. Innovative use of state-of-the-art multisensory Augmented Reality technology will enable direct interaction with the dance, providing new experiences and training in traditional dance which is key to ensure this rich culture asset is preserved for future generations.	https://www.schedar.eu/about/

VIRTUAL AND AUGMENTED REALITY FOR MARITIME ARCHAEOLOGY	The project iMARECULTURE (Advanced VR, iMmersive Serious Games and Augmented REality as Tools to Raise Awareness and Access to European Underwater CULTURal heritage) is focusing on raising European identity awareness using maritime and underwater cultural interaction and exchange in the Mediterranean Sea. The aim of the project is to bring inherently unreachable underwater cultural heritage within digital reach of the wide public using virtual visits and immersive technologies. This keynote will present results in respect to virtual and augmented reality interfaces for underwater environments. In terms of virtual reality, two different types of applications will be illustrated. The first one is a dry-visit solution for exploring ancient sites and it is focused on the general public. The second one is a serious game that aims at teaching maritime and archaeologist students the main principles of 'site formation', 'surveying' and 'excavation'. Moreover, a novel augmented reality underwater interface will be presented which can detect square markers in poor visibility conditions as well as serve as a virtual guide for divers that visit underwater archaeological sites. Evaluation results will be presented for all applications	https://www.chnt.at/virtual-and-augmented-reality-for-maritime-archaeology/

	illustrating the effectiveness of the interfaces.	

Greece		
Best practices	**Description**	**Link**
AR books for young students that teach pronunciation "LIveBooks: Learning the Letters with Renata"	Students can scan a letter they see on the book to reveal the digital content The AR content shows a student how to write and pronounce a letter Children can take a selfie with Renata, the 3D cat that helps them learn about the letters, increasing their engagement and enjoyment	https://www.livebooks.gr/%ce%bc%ce%b1%ce%b8%ce%b1%ce%af%ce%bd%cf%89-%cf%84%ce%b1-%ce%b3%cf%81%ce%ac%ce%bc%ce%bc%ce%b1%cf%84%ce%b1-%ce%bc%ce%b5-%cf%84%ce%b7-%cf%81%ce%b5%ce%bd%ce%ac%cf%84%ce%b1/
Web & interactive educational games for Museums, Connection of the National Monuments Archive with Europeana Digital Collections | Ministry of Culture & Sports	Interactive AR games that educate young people on museum exhibits Interface allows users to learn about each specific exhibits	https://www.dataverse.gr/index.php/solutions/vr-ar/

School Books that have been enhanced with AR "School AR"	Due to the economic problems of the country, there is no possibility for new books. Students are exposed to new technologies and practices in education at no great cost. The objects are adapted to the material of the course and either explain or extend it. It creates an interactive learning environment where the student observes the 3D object in space and perceives it better.	http://users.sch.gr/samgeorg/schoolar/wordpress
AR book for young students that teaches them about the solar system "The Solar System in 3D"	Children can scan a book page and the planet on the page will appear as a 3D image on their mobile device They are able to see more details about each planet on the 3D plane Students use AR to "travel" to the ESA space station	https://www.livebooks.gr/%ce%b5%ce%b9%ce%ba%ce%bf%ce%bd%ce%b9%ce%ba%ce%ae-%cf%80%cf%81%ce%b1%ce%b3%ce%bc%ce%b1%cf%84%ce%b9%ce%ba%cf%8c%cf%84%ce%b7%cf%84%ce%b1-%cf%84%ce%bf-%ce%b7%ce%bb%ce%b9%ce%b1%ce%ba%cf%8c/

United Kingdom		
Best practices	**Description**	**Link**
Primary School Westgate Primary School Warwickshire (2019)	A 'world first' augmented reality teaching resource which will be evaluated over the next two years, developed by Road Safety GB. Called 'Arility'. With 360 degrees' visuals and entertaining sound effects, children interact directly with augmented reality characters to identify risks and learn to make safe choices. The resource will test children on a range of common scenarios. Including how to use a pedestrian crossing, retrieving a ball from the road and how to cross the road with a bike. The app is being trialed at the school, however after the 2nd September 2019 the app was made available for download and for teaching across all primary schools.	https://roadsafetygb.org.uk/news/primary-school-road-safety-enters-a-new-dimension/
AR application in Modern Foreign Language Flash Cards **'Aurasma'**	AR can be very useful to reinforce how to pronounce particular words or phrases. Through the creation of display flash cards, with the MFL words, and creating a short video aura of each with the teacher speaking the word in the language. Pupils can scan words or phrases they are unsure of and can listen	http://www.innovatemyschool.com/ideas/augmented-learning-using-augmented-reality-in-schools

	to this again and again to improve their language skills.	
AR versions of textbooks **'Huber Verlag'**	Students can use their smartphones to scan a textbook page and reveal related digital content Provides teaching materials for over 30 language programs ranging from textbooks and self-study materials, dictionaries, audiobooks and reading material, as well as specialist literature. Complementing existing forms of teachings. Students can scan pages of corresponding books to reveal digital icons, play audio or video files related to the lessons.	https://www.wikitude.com/showcase/learning-languages-made-easy-with-ar/
Grimsby Institute of Further & Higher Education	Transformed teaching practice to not only provide their students with necessary skills to be active participants of the future workforce, but also provide a pipeline into the local industry. Grimsby's use of Augmented Reality allows them to provide 'real life' work experiences to better prepare students for working life. For example, they have an offsite training facility (Modal) which acts as a fully immersive marine and logistics simulator hub, where students can experience day-to-day high pressure scenarios of working on a ship.	https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/791931/DfE-Education_Technology_Strategy.pdf

	'The immersive experiences that we provide mean students can experience things going wrong in a simulated environment before they go wrong in real life. It prepares them for high-risk scenarios in their career that could be life-saving. Additionally, we provide students with an industry standard technology that gives them a better opportunity to find and transition into their chosen career paths'.	
Tool for creating AR lesson plans ***'3DBear'***	Users can build and share scenes using 3D models with this app's object library or content imported from Thingiverse. Teachers create and assign lessons through a web-based dashboard, and students use the app to create scenes. Ready-made lesson plans cover a range of topics.	https://www.3dbear.io/product
Tool for exposing students to new word stimuli ***'Catchy Words AR'***	Primary school teachers can utilize this free word game that combines learning with movement. Without touching the screen, students walk around "catching" letters with their devices to solve word puzzles.	https://twiceapps.com/catchy/catchy.html
Tool for creating virtual exhibits and tours that enable learning and storytelling on the way	This design tool allows students with coding experience to create virtual 3D worlds, create infographics and tell stories through virtual exhibits and tours. Teachers create a class and post assignments. Images and 360-degree photos can be uploaded, and a	https://cospaces.io/edu/

'CoSpaces Edu'	companion app is available.	
An AR image breakdown of concepts, and syllabus processes ***'JigSpace'***	This educational app offers a library of knowledge, and each "Jig" is a 3D presentation of how everyday things work, explained in simple steps and viewed visually in augmented or virtual reality. Students can view the human heart, the solar system, inventions and other objects from a variety of angles.	https://jig.space/
AR hologram for observation learning ***'MERGE Cube'***	MERGE Cube lets students "hold a hologram" in their hands. Available through popular retailers for about $15, the foam cube features unique designs on each side. When held in front of a device's camera while using one of MERGE's apps, the cube transforms into a digital 3D object or scene that can be viewed from different angles by rotating the cube. With a MERGE Cube, teachers can create lessons and activities to explore STEAM concepts, illustrate complex systems, and enable students to "experience" history or science. For example, the DinoDigger app has students excavate the earth to uncover dinosaur fossils. The HoloGlobe app lets students "hold" NASA and NOAA visualizations of the earth in the palm of their hands. (Educators may also check out Google SkyMap, a hand-held planetarium that can be used to identify stars, planets, nebulae and more.)	https://mergeedu.com/cube

AR tool for the gamification of review based learning ***'Metaverse'***	Recommended for ages 13 and older, this free platform (website and app) allows users to create and share interactive content in augmented reality. Educators can use the tool to gamify learning through warm-up exercises, review games or formative assessments. Students can download the free mobile app to participate in teacher- or user-created games, location-based experiences, scavenger hunts, geocaching and more.	https://studio.gometa.io/
Create AR objects to be shared, for observable learning ***'Moatboat'***	Moatboat is a creation engine app for augmented reality and virtual reality. The user gives simple commands to add objects and give them behaviors. Users can then "place" their creations on a table to share with others.	http://www.moatboat.com/
AR fuelled explanation for question breakdowns. ***'Photomath'***	Allows students to scan a math problem from a physical worksheet, then virtually walks them through calculation steps using animation. AR apps can help students understand mathematical concepts through visualization and interactive 3D models.	https://photomath.com/en/
Virtual Language Assistant ***'Mondly AR'***	Is a mobile application that introduces the user to a virtual character called Mondly, with whom you can talk to and observe in various contexts. Bringing technologies like chatbot and speech recognition, to facilitate relevant conversations with virtual characters in the language you are aiming to learn.	https://www.mondly.com/ar

	The app offers virtual lessons, real-life conversations in 15 languages and provides instant feedback based on your language learning performance and progress. The characters appear in the same room as you, through the AR embedded in the app, providing an interactive and immersive experience intended to improve attentiveness, in relation to traditional language learning methods. The app currently has 45 million users, and offers both free and paid services.	
Virtual Language Assistant ***'Mondly AR'***	Is a mobile application that introduces the user to a virtual character called Mondly, with whom you can talk to and observe in various contexts. Bringing technologies like chatbot and speech recognition, to facilitate relevant conversations with virtual characters in the language you are aiming to learn. The app offers virtual lessons, real-life conversations in 15 languages and provides instant feedback based on your language learning performance and progress. The characters appear in the same room as you, through the AR embedded in the app, providing an interactive and immersive experience intended to improve attentiveness, in relation to traditional language learning methods. The app currently has 45	https://www.mondly.com/ar

	million users, and offers both free and paid services.	
AR tool that identifies nearby objects for the purpose of language learning ***'Argo'***	Argo is an augmented reality application that helps people to learn a new language by challenging them to identify objects around them in the language that they want to learn. It facilitates peer-to-peer learning that is engaging, fun and takes advantage of the user's environment.	http://monamishra.com/projects/Argo.html
AR animated storytelling and puzzles ***'Popar Toys'***	This app changes the way that students engage with stories and puzzles. The books and puzzles that can be used with the app come to life with animation and readalongs as the children make their way through the stories. This app brings stories to life, which can help children become more interested in a range of topics. They can even engage with interactive books about the world and the solar system, helping bring science to life.	https://popartoys.com/p/smart-products

Finland		
Best practices	**Description**	**Link**
Merge Cube	·The Merge Cube Lets you hold digital 3D objects, enabling an entirely new way to learn and interact with the digital world. ·There are many applications that can be downloaded for use with the Merge Cube (Merge EDU apps) on your iOS or Android devices. It can be used for e.g. learning anatomy, exploring a DNA molecule, following or creating a story in other languages, etc. In Finland, teachers have used it e.g. for language teaching through English gamified stories, as seen in the blog text by Matleena Laakso.	https://mergeedu.com/cube https://www.matleenalaakso.fi/2018/10/merge.html
Arilyn App	Arilyn is a Finnish AR company that provides many different AR services that can be used for products, exhibitions, also teaching. It can be used for Show & Tell, creating virtual galleries, creating stories without borders etc.	https://www.arilyn.com https://speakerdeck.com/matleenalaakso/lisatty-todellisuus-opetuksessa?slide=33
Figment	Figment is an AR application that can be used to add visible effects and characters to an environment, as many other applications. But Figment can also create portals through which you can move to 360 environments. It can be	https://www.matleenalaakso.fi/2018/10/figment.html

	therefore used to tell stories with great results, which has been tried in some Finnish schools.	

Spain		
Best practices	**Description**	**Link**
CoSpaces Edu	It is an App that includes both AR and VR. It includes a complete set of tools to create complete 3D elements and environments, such as virtual presentations, infographics and animated stories, adapted to any subject of study. Students can live an immersive experience in virtual environments specially designed for learning and practising English vocabulary, for example. For teachers, this app includes very effective class management, homework assignment and progress tracking functions. CoSpaces Edu has a free version and a paid version with a wider range of functionalities.	https://cospaces.io/edu/

AltspaceVR	This is a virtual space to encourage interaction with people from all over the world. It can be used for learners of English to practice and reinforce their communication and conversation skills in fully immersive and realistic environments. These environments are not only academic; users can access game rooms, conversation clubs, karaoke, stand-ups, conferences, concerts, live performances, among other social events. AltspaceVR is a free application available on Windows 10. All you need to do is create a user account, customise an avatar, browse the list of scheduled events and start practising English.	https://altvr.com/
Aumentaty	Aumentaty is an initiative promoted by LabHuman (from the Polytechnic University of Valencia) with the aim of providing Augmented Reality software solutions in various fields, especially education. There is an educational community and other teachers' creations can be used. The so-called Aumentaty Creator and Aumentaty Scope will allow you to create and visualise AR content. Teachers and students can create AR scenes quickly and easily (to visualise 3D models, in .dae, .obj, .3ds and .fbx, just drag the name of the model over the	http://www.aumentaty.com

	selected marker).	
VirtualSpeech	This platform is designed especially for those who have an intermediate or advanced command of English and are interested in learning vocabulary for professional environments. It offers real immersion situations in interviews and business meetings, conferences, presentations and speeches, and reinforces argumentation skills and fluency in oral expression. VirtualSpeech is a paid platform available on Android and iOS devices. The subscription includes a wide variety of courses that reinforce public speaking skills, design effective presentations, memorise speeches, manage job interviews, among other situations typical of work and corporate environments.	https://virtualspeech.com/

6. Conclusion

A common conclusion of our survey research and literature review around augmented reality (AR) in education, is that its applications can enhance the learning process, learning motivation and effectiveness. However, in some countries, such as Cyprus and Greece, the use of AR technology in education is limited. From our partnership, the United Kingdom seems to be the country with more AR applications in the school environment.

Most teachers seem to agree that continuous training would be really important for them to be able to effectively use AR technology in their classroom. Despite that, our survey showed that there is a significant lack of relevant training for teachers as only 1 of a total of 60 participants has been trained in AR.

Therefore, with this Erasmus+ project, we aim to develop a new AR application, especially designed for language teaching, and train a number of teachers in the use of this promising technology.

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ANNEX

QUESTIONNAIRE

This questionnaire is shared with you to determine what the needs of EFL students are and whether or not AR can improve EFL teaching. This questionnaire will be the basis of the AR application and handbook this project aims to develop.

This questionnaire is mostly for EFL professionals. Be assured that this questionnaire respects the European regulation GDPR. All the data gathered in this questionnaire will only be used internally to improve the content we offer and to report to the British National Agency for Erasmus+ projects. Your data will not be shared with any other organisation.

Thanks in advance for your contribution!

Estimated time: 5 min

DEMOGRAPHIC INFORMATION

D1. What is your gender?

1. Male
2. Female
3. Other
4. Prefer not to say

D2. How old are you?

1. 20-35
2. 36-50
3. 51-65
4. Prefer not to say

D3. Which city/town do you work in?

_____

D4. Would you consider your school to be in an urban or rural area?

1. Urban-city (more than 100 000)
2. Urban- town (less than 100 000)
3. Rural

D5. Which job title matches your role best?

1. Main teacher in the classroom
2. Assistant teacher (for the class/for one child)
3. Subject teacher
4. Other **/please specify/**_____

D6. Years of experience in teaching at school

1. less than 1

   _____ write number **/please specify/**

D7. Level of education

1. MA degree or higher
2. BA degree
3. High school

Augmented Reality (AR) EXPERIENCE

Section 1

1. Have you ever used Augmented Reality (either in your classroom or personal use)

1. Yes
2. No
3. Not sure

2. If yes, please provide some details

3. Have you ever used Augmented Reality in EFL or ESL (English as a Foreign/ Second Language) teaching?

1. Yes **/> Section. 2/**
2. No

4. If you had the opportunity, would you use AR in your classroom?

1. Yes
2. No

5. What do you consider as benefits of using AR in an EFL classroom?

(Choose all that applies)

1. Increased content understanding
2. No special equipment is required
3. Learning language associations
4. Long-term memory retention
5. Practical learning
6. Improved collaboration

7. Increased student motivation

8. Other (please specify):

6. What do you consider as obstacles when using AR in an EFL classroom?

(Choose all that applies)

1. Lack of training

2. Dependence on hardware

3. Content portability issues

4. Not practical

5. Other (please specify):

Section 2

(Only for those you answered yes in Q3)

7. From your experience what are the benefits of using AR in EFL teaching?

(Choose all that applies)

1. Increased content understanding

2. No special equipment is required

3. Learning language associations

4. Long-term memory retention

5. Practical learning

6. Improved collaboration

7. Increased student motivation

8. Other (please specify):

8. What do you consider as obstacles when using AR in an EFL classroom?

(Choose all that applies)

1. Lack of training

2. Dependence on hardware

3. Content portability issues

4. Not practical

5. Other (please specify):

7. Did you receive any training in the use of AR?

1. Yes
2. No

8. If yes, provide more details (title of the course, duration, was it funded by your employer?)

9. Please rate your confidence in the following **/ONE ANSWER IN EVERY ROW/**	Very confident	Somewhat confident	Not confident at all	I'm not sure what it means
9.1. I can use AR technology to reach the educational goals I have set	1	2	3	4
9.2. I can use AR technology to enrich the learning environment	1	2	3	4
9.3. I can use AR technology to develop pupils' interest, motivation and satisfaction during the learning process	1	2	3	4
9.4. I can use AR technology to design and develop lessons where AR technology can be applied	1	2	3	4
9.5. I can use AR technology to teach different subjects to pupils?	1	2	3	4

10. Which of the following statements would you most agree with? **/ONE ANSWER IN EVERY ROW/**	I agree	I somewhat agree	I don't agree
10.1. AR is a valuable teaching tool	1	2	3

10.2. AR is very useful in EFL teaching	1	2	3
10.3. Students' performance has improved after the use of AR	1	2	3
10.4. The benefits of AR outweigh the obstacles	1	2	3

11. What do you want to learn more about AR in EFL teaching?

12. Describe how you used the AR in your teaching:

13. Are you aware of any other uses of AR in EFL?

14. What would you like to see in an AR application for EFT