Education Resilience in Europe

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Project Report - FizziQ for Diversity

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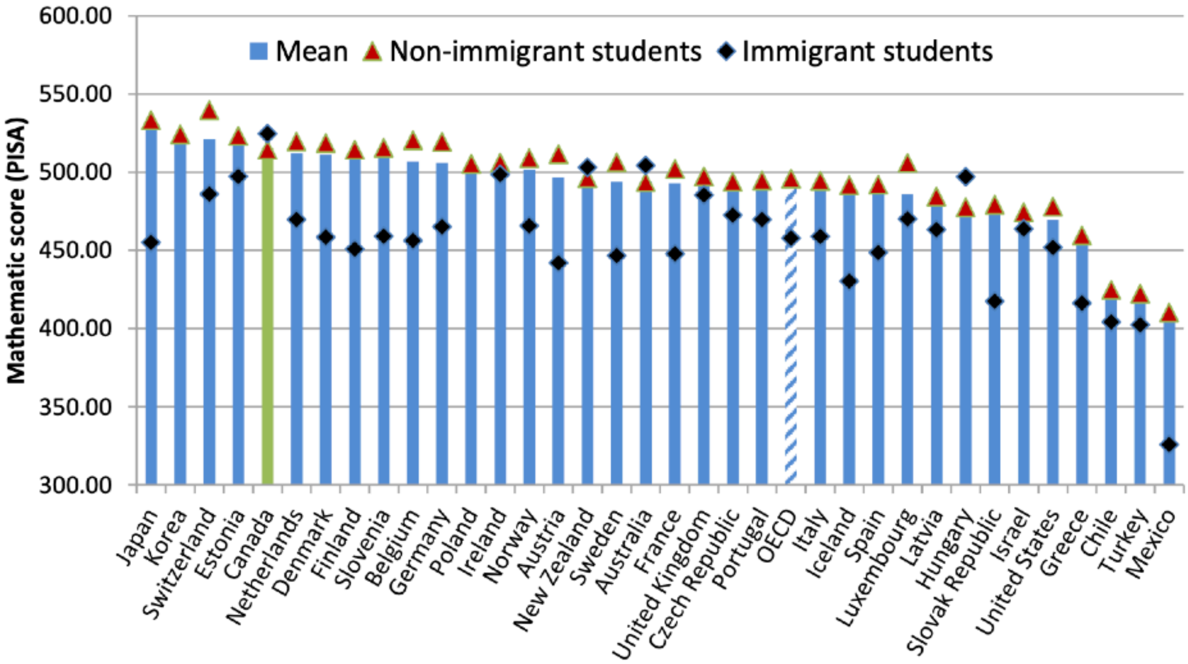
1. Introduction

The widespread humanitarian, environmental, and economic crises have caused a massive influx of migration and displacement of children and their families around the world. In recent years, Europe has become a destination for families seeking a better life or escaping political unrest, but this migration has brought with it a range of challenges for the integration of these children into their new educational environments. Cultural, linguistic, environmental, and socio-economic barriers have made it difficult for these children to seamlessly fit into their new classrooms.

The **Education Resilience in Europe Initiative** is tackling the challenges posed by the global migration crisis and its impact on the education of children. In collaboration with **Scientix**, the Community for Science Education in Europe, the initiative is working to provide solutions that help children from diverse backgrounds smoothly integrate into new educational environments. The **STE(A)M Partnerships program** of Scientix promotes collaboration between organizations to develop new approaches for creative and innovative STEM education and learning opportunities. The Project, FizziQ for Diversity, has been selected by this initiative and aims to use the FizziQ Junior Ecosystem to use digital tools and provide access to high-quality science education to assist migrant children in their integration process.

1.1. Literature Review

Immigration has historically and will continue to be a significant aspect of European societies. This is especially important as the European Union experiences an increase in migration, with the latest European Union Statistics showing that in 2021 alone, 2.3 million immigrants entered the EU from non-EU countries - an 18% increase compared to 2020. Most of these migrants are from countries with vastly different social and political cultures and lower economic standing than most EU Member States. In order to effectively integrate these individuals, there is an immediate need for increased knowledge sharing on cultural and social integration processes (Heckman, 2008). Education, whether formal, informal, or non-formal, can play a pivotal role in this process, and it's imperative to share information about past successes and failures. Despite efforts to integrate migrant students into European schools and communities, there is still a significant gap in educational and learning abilities between migrant and non-migrant students. This gap between the academic performance of migrant and non-migrant students is noticeable as early as the end of primary school education, as migrant children tend to score substantially lower than native children (Stanat et al., 2007). The OECD PISA studies (2006) on the academic skills of 15-year-olds, including reading, mathematics, and science, also reveal substantially lower achievement by migrant children. Figure 1 below illustrates the difference in mathematical performance between native students from selected countries and immigrant students.



Source. PISA 2015. OECD Child Well-Being Data Portal.

Figure 1: Mathematics performance at age 15 (PISA), by migrant status

(Tackling Child Poverty - O. Thévénon - OECD Social, Employment and Migration Working Papers No. 220)

The upcoming report will explore how scientific experimentation pedagogy and research on inquiry-based science education can be utilized to enhance the learning outcomes and abilities of migrant students.

1.2. Importance of science in school curriculum and barriers for science education

Research (including Howitt et al. 2011; Peterson and French 2008; Inan et al. 2010) indicates that implementing inquiry-based science education in early childhood education was associated with significant developmental benefits for young children. Science education, when viewed as a process of knowledge acquisition, can lead to rich conceptual growth, provide a meaningful context for children's learning, and aid in the development of language, literacy, and math skills (Gerde, 2013). When children participate in science activities, they are encouraged to express their observations, pose inquiries, and make predictions, record their observations - abilities that are crucial for enhancing their language skills and critical thinking skills in the long run (Dickinson and Porche 2011).

However, Early et al. (2010) notes that efforts towards science education and scientific experimentation for younger children are less when compared to other subject areas. This manifested both in terms of the lack of science laboratories (Nayfeld et al. 2014) as well as insufficient time spent by teachers in science (Hanley et al. 2009). One of the reasons behind this is the inadequate methods of learning and teaching science in schools (Rocard et al., 2007). As per the Ministry of Education (Youth and Sports CR, 2010), less than 15% of European Students report being satisfied with the quality of science teaching within their schools, and over 60% of students report that they do not find the science teaching to be interesting enough. Most of the laboratory work done by students as a part of their Science curriculum, even in secondary schools, is focused on content and skill-based learning outcomes (Ment et al. 2007) rather than problem solving and inquiry-based methods which have been proven to be more effective.

1.3. The pedagogy of Inquiry-Based Science Education

Research in the field of children's cognitive abilities and critical thinking has established that the most effective means of improving these skills is through inquiry methods, investigation, and application of knowledge in new contexts. Inquiry-based science education (IBSE) is a teaching and learning strategy that follows the constructivist approach (Eisenkraft, 2003; Llewellyn, 2002; White & Frederiksen, 1998). Furtak et al. (2012) breaks down the term of "science inquiry" into three sub-categories - the pedagogical strategy, the skill set learnt by the student, and the cognitive aspect of understanding the inquiry processes. The American National Research Council (NRC, 1996, 2000) defines inquiry as 'a multifaceted activity that involves making observations; posing questions; examining books and other sources of information to see what is already known; planning investigations; reviewing what is already known in light of experimental evidence; using tools to gather, analyze and interpret data; proposing answers, explanations and predictions; and communicating results' (NRC, 1996, 2000, p. 23). Based on the standards set by the NRC on IBSE, the process of classroom inquiry is constituted by six important features - 1. Addressing scientific questions 2. Carry out experimentations and investigations to gather evidence 3. Prioritize the collected evidence in relation to the questions asked 4. Formulation of explanations for the evidence collected 5. Connection of the explanations to scientific knowledge, and 6. Communication and Justification of the Process.

Tuenter et al. (2012) outline three ways in which IBSE contributes to the overall developmental outcomes of children - increasing their motivation to learn science, the application of research skills, and by constructing a deeper learning of knowledge. IBSE addresses the curiosity of pupils and helps them in formulating a research question in their topic of interest. This involves the collection and recording of information from diverse sources, communication with others, interpretation of findings, and drawing meaningful conclusions. By going beyond the mere recording of data, the process of IBSE improves their conceptual understanding of scientific phenomena (Minner, Levy, & Century, 2010; Schroeder, Scott, Tolson, Huang, & Lee, 2007). Further, IBSE encourages open ended inquiries (Liang & Richardson, 2009) to nurture the inherent curiosities of children to ask questions. By encouraging a process of "active learning" through the investigation of the surrounding world by a process of formulating questions, experimenting, and testing the findings - IBSE places the student at the center of the learning process, with the teacher serving as a guide. IBSE therefore provides an effective way of learning science as its pedagogical approach is to focus on the child's motivations and their own interests and enable them to conduct their own experiments (Braund & Driver, 2005; Murphy & Beggs, 2003). This improvement of educational outcomes through IBSE is seen to be positive across all educational levels, from primary schools to college-level education (Cuevas et al. 2005). The positive results of this approach were also observed across diverse social categories, including gender, ethnicity, religion, socio-economic status, and linguistic proficiency (Cuevas et al. 2005).

1.4. Problems faced by migrant children and the role played by educational institutions and IBSE.

As Europe continues to welcome more migrant families, it is concerning that migrant children often perform below average within formal educational institutions. It is critical that these children are able to integrate into the educational system of their new country in order to improve their cognitive skills and developmental outcomes. However, they often face barriers such as language barriers, financial constraints, and cultural and religious differences with native students. As language proficiency is a key factor in academic achievement, migrant students face the additional challenge of acquiring the language and culture of the host country. Given these challenges, it is important to examine the role of educational systems and tools such as IBSE in promoting cross-cultural learning and collaborative environments that enable students to learn from one another and thrive in multicultural settings.

Insights from PISA (The Program for International Student Assessment) and TIMSS (Trends in International Mathematics and Science Study) show that migrant students perform significantly worse in achievement tests when compared to the non-migrant or native students, with the average achievement gaps amounting to 25 score points in Mathematics and 28 score points in science in the OECD countries. The achievement gaps also vary greatly amongst the migrant students based on their socioeconomic backgrounds. A study by Schneeweis (2011) showed that the integration of migrant children into educational institutions has been found to be positively correlated with their overall integration. The study showed that the amount of time spent in school and early education are strongly associated with better integration outcomes in both math and science. It also emphasized the importance of supporting the education of migrant children from an early age for success within the educational system and for their academic and cultural integration. Another study is that of Ellwood et al. (2018) who conducted a qualitative study in two settings, one involving the use of IBSE tools within a classroom and the other at an individual level. This study's results demonstrate that when these activities were carried out in a classroom environment that encouraged communication and focused attention, it had a positive impact on students' motivation and academic achievements. This same study underscores the crucial role of student social interactions during IBSE experiments. The researchers found that when students engaged in meaningful discussions with their peers about their short-term and long-term goals, provided and received regular feedback on their progress, and discussed the challenges they encountered during the activity, this environment was essential in cultivating their perseverance and eagerness to tackle more greater challenges.

2. The project - FizziQ for Diversity

2.1 Project objectives

The refugee crisis in recent times has led to significant challenges for many OECD countries, particularly in terms of accommodating and integrating large numbers of refugees. Among these vulnerable groups, refugee students face particular difficulties due to their forced displacement, and education systems often fail to meet their unique needs. This can negatively impact their potential for integration, which is crucial for their academic success and emotional well-being. Addressing these challenges is therefore critical for ensuring that refugee students can thrive in their new home countries. The "FizziQ for Diversity" project aims to assess the effectiveness of the FizziQ Junior app in improving the learning outcomes of migrant children in European classrooms. This project builds on existing research that highlights the positive impact of scientific experimentation and Inquiry-based Science education on the integration and academic achievement of migrant children.

- **Research Question:** How can digital technology tools built on an Inquiry-based Science Approach, such as FizziQ Junior, promote greater inclusivity for migrant students from different social, economic, and geographical backgrounds?
- **Objective:** The aim of the project was to evaluate the effectiveness of digital Inquiry-Based Science Education (IBSE) tools in facilitating the integration of migrant children into new educational environments.

2.2. An insight into The FizziQ Junior Application

The integration of practical work in STEM fields is crucial for students' growth and development. However, this hands-on learning experience is often hindered by the high costs of scientific equipment, trained instructors, and materials. The FizziQ Junior app offers an innovative solution to this challenge by leveraging the technology of tablet devices to bring scientific experimentation to students and teachers in a cost-effective and user-friendly manner.

Designed in collaboration with La Fondation la main à la pâte and the French Ministry of Education, the FizziQ Junior app offers a comprehensive and inclusive approach to science education. With its tablet sensors and intuitive interface, students are able to conduct a range of experiments and develop their analytical and reasoning skills in a hands-on, inquiry-based manner. The app's built-in experiment notebook allows students to keep track of their work and progress over time, while its collaborative features foster a truly interactive learning environment between students and teachers.

FizziQ Junior is a useful tool for democratizing access to science education, making modern experimentation tools available to students and teachers regardless of their location or resources. Whether in the classroom or in the field, the app provides students with a dynamic and engaging environment to learn about the world around them. See Appendix 1 for more information on FizziQ Junior.

2.3. Inquiry-based Science Education using FizziQ Junior

The inquiry-based approach is an active, student-centered teaching method that focuses on hands-on scientific learning. In this approach, students play a key role in the scientific inquiry process, asking questions, designing and conducting experiments, analyzing data, sharing their results, and reflecting on the entire process. Through this approach, students develop critical thinking and problem-solving skills, as well as a deeper understanding of scientific concepts. The five steps involved in inquiry-based instruction include: asking questions, planning and conducting experiments, analyzing and interpreting data, communicating results, and reflecting on the process. The ultimate goal is to cultivate a more robust and meaningful grasp of science.

FizziQ Junior supports investigative learning in cycle 3 classes, and is targeted at students aged between 8 to 12 years. The application features a digital experiment notebook that facilitates the scientific inquiry process, allowing students to easily document their observations, hypotheses, and conclusions. Additionally, students have access to a range of digital measuring instruments for sound, position, movement, and more, empowering them to thoroughly document their reasoning and add meaningful measurements to their experiment notebooks. The ability to exchange activities and notebooks between teachers and students, along with access to a wealth of educational resources from the La main à la pâte foundation and Trapèze.digital, make FizziQ Junior a complete learning solution.

The educational aims of FizziQ Junior are to enhance students' learning in Science and Mathematics through the implementation of hands-on experiments, boost the integration of digital practices into the classroom, and support teachers in conducting experiments using the inquiry-based approach. The application is designed to benefit both students and teachers, with students using the app to experiment and document their findings, and teachers leveraging its features to enhance their teaching practices. Furthermore, the app's accessibility outside of the classroom enables students to continue their experimentation and learning at home, providing new and exciting opportunities for scientific exploration and discovery.

2.4. Project Research Methodology

The FizziQ Junior app was piloted in six classrooms across Europe with a focus on primary and middle school students between the ages of 8-14 who have been affected by migration. The app was tested in 6 classrooms across Europe, with a total of 121 students, among which 53 students were from migrant families originating from a variety of countries such as Russia, Albania, Egypt, Serbia, Ukraine, Latvia, Germany, Canada, the Roma community, and Poland.

Table 2 provides a detailed account of the specificities of the pilot classrooms, including the countries they are located in, class sizes, total number of foreign students, and their countries of origin.

	Country	**Class size**	**Total number of foreign students**	**Their countries**
Teacher 1	Greece	15	6	Russia, Albania, Egypt
Teacher 2	Greece	13	5	Albania, Serbia
Teacher 3	Ireland	17	6	Ukraine, Latvia, Roma community
Teacher 4	Poland	28	14	Ukraine, Germany
Teacher 5	Slovakia	18	18	All Roma community
Teacher 6	Ukraine	30	4	Canada, Poland

Table 2: Details of Pilot Classrooms, Class Sizes, and Foreign Student Demographics

Implementation of the Project: The pilot classrooms were identified with the assistance of the Scientix community. Following this, an initial project launch meeting was conducted on March 10th, where the pilot teachers were briefed about their role, logistics, timeline, expected commitment, and learning outcomes from the project.

To implement the project, the first step was to introduce FizziQ Junior materials to teachers by disseminating them within their networks. Relevant activities were identified and translated from French to English. The translated materials can be accessed on the [Fizziq Junior website](). Comprehensive materials were developed to assist both teachers and students in utilizing the FizziQ junior app effectively. The complete list of resources has been annexed to the report (Annexe 2). Subsequently, one-to-one calls were scheduled for each of the 6 pilot teachers to understand their preferred activities and align them with the science curriculum they had planned for April and May. These calls were held in late March andearly April. After identifying the specific activities, they were modified or new activities were created andshared with the teachers by mid-April. These activities were then implemented by the pilot teachers for two one-hour sessions between mid-April to mid-May. Following the implementation, a one-hourfeedback session was held to assess the app's effectiveness in achieving its intended outcomes.

<u>An overview of steps involved in the piloting phase of the app:</u>

1. Consultations with the teachers to identify the activities they wanted to use in their classrooms.
2. A one-hour training session on FizziQ Junior and preparation for the first session with thestudents.
3. A one-hour session to review and refine the customized learning materials.
4. At least two class sessions to conduct an activity with the class
5. A one-hour feedback session to gather information on the app's effectiveness in achieving its objectives.
6. A one-hour global feedback session with all participants

<u>An overview of the project timeline is as follows:</u>

- Phase 1 (1 month): Project organisation. Creation, identification, and translation of learning material. Finalization of 6 test classrooms for piloting the app
- Phase 2 (2 months): Project launch meeting with teachers to convey expectations and implementationlogistics. One-on-one calls with teachers to identify learning materials and activities fortheir classrooms. Sharing of customized learning materials with teachers. Development of specific functionalities in FizziQ Junior.
- Phase 3 (1.5 months) : Deployment of learning materials in classrooms in 2 sessions
- Phase 4 (0.5 month) : Detailed feedback sessions with teachers to gather their feedback on the app and its effectiveness in improving the integration of migrant children in new educational environments.

<u>Expected learning outcomes from piloting the app and feedback from teachers:</u>

The Fizziq for Diversity project aims to achieve three main learning outcomes through piloting the app in classrooms and gathering feedback from teachers. These outcomes are as follows:

- Evaluation of the effectiveness of the app design: The project aims to evaluate the effectiveness of the app design in serving the needs of migrant children. Specifically, it aims to identify how the user interface and content of FizziQ Junior can be improved to enhance its ergonomics, accessibility, and internet access, and to make the language more inclusive and user-friendly for a diverse range of students. Moreover, the possibility of incorporating new and innovative ideas

into the app will be explored, such as motivational messages or reward points, which can motivate students to consistently engage in learning and experimentation.
- Suitable pedagogical practices for adaptation to IBSE : The project also seeks to identify suitable pedagogical digital tools that teachers and parents can use to help students develop inquiry-based thinking and education. The project aims to determine which aspects of experimentation the students were most interested in, which types of activities fostered greater collaboration and discussion between migrant and non-migrant students, and the effectiveness of additional resource materials provided to teachers and students. Furthermore, language barriers faced by students and ways to address them will also be probed.
- Onboarding teachers : The project aims at studying how to motivate the education community to adopt the new technologies. What are the main drivers behind teachers' adoption, how to create a community around these new tools, how to best distribute resources and experience.

Through feedback from teachers, the project aims to identify the priority areas that have the greatest impact on the integration of migrant children in new educational environments. This includes exploring the most effective ways to use digital IBSE tools to promote language acquisition, cultural integration, and academic success among these students. By identifying these priority areas, the app's features and design can be better tailored to meet the unique needs of migrant children and support their educational success.

3. Results

3.1. Evaluation of FizziQ Junior

Teachers provided feedback through a video call lasting from 20 to 45 minutes. A summery was provided to teachers for validation. This summary is available in the Appendix. Based on the feedback received from the teachers, the following observations and suggestions were made about the FizziQ Junior app.

Positive Aspects

1. Intuitiveness and Ease of Use: Teachers found the FizziQ Junior app very intuitive and easy to navigate. Students could easily understand the app functions, and teachers appreciated the ease with which they could integrate it into their lessons.
2. Engaging Learning Tool: The app sparked curiosity and facilitated a deep understanding of the subjects at hand. Teachers reported a high level of student engagement and noted that even the usually noisy students remained focused during the sessions using the app.
3. Real-World Application of Knowledge: Lessons conducted using the FizziQ Junior app encouraged students to apply their knowledge to real-world situations. Students can see the relevance and applicability of what they were learning, which helped increase their interest and engagement. Also doing outdoor activities is very rewarding and helps with learning.
4. Facilitates Teamwork and Inclusiveness: The app was found to promote team integration, with students becoming more friendly and communicative among themselves. It also fostered a sense of inclusiveness, especially for migrant children who were excited to share their cultures and countries.
5. Versatility of Subjects and Activities: The app was used in various subjects, including music, English, math, and science. Teachers appreciated the range of activities and menus that they could use, includingsound measurements, color analysis, and compass navigation.

6. Enhances Scientific Reasoning: Teachers noted that the app significantly improved children's understanding of scientific reasoning. It allowed students to see the logical sequence of scientific processes, thereby enhancing their appreciation of science.
7. Seamless Functionality: Despite initial downloading issues on Android, which were quickly resolved, the app functioned smoothly and without significant bugs. Teachers also found the creation of QR codesfor activities straightforward and the app's video and guidelines helpful.
8. Use of technology: Students discover that tablets and smartphones can be used for other purposes than just games. It makes them more comfortable in writing and develops their language skills. Parents who are not used to technology were very pleased to see that children acquired skills in using tablets forserious use.

Improvements needed

1. Language Limitations: Whereas some teachers found useful to use the English language as a common language for all students coming from different origins, several teachers mentioned the language barrieras a hurdle. Many students were non-native English speakers and the app was not available in their languages. Making the app available in more languages was a common suggestion, especially languages from the communities of origin.
2. Need for More Features: While teachers appreciated the available menus and activities, they expressed a desire for more types of measurements. Suggestions included additional instruments for measuring temperature, energy, and electricity, and a feature for learning the alphabet.
3. Need for Collaborative Features: One suggestion was to include a collaboration feature in the app to facilitate shared work among students.
4. Need for More Resources: Teachers expressed a desire for a bank of pre-made activities and the provision of school accounts to further streamline the app's usage.

Based on the teachers' feedback, FizziQ Junior provides several notable advantages when used to teach science to migrant children. These advantages will probably be shared by other similar software to FizziQ Junior

Language Accessibility: Despite the language barrier, FizziQ Junior is designed to be intuitive and user-friendly, making it accessible even for non-native English speakers. The visual nature of many of the app's features allows students to understand and engage with the material, regardless of language proficiency.

Inclusive Learning: The interactive nature of the app fosters a sense of inclusiveness, as all students can participate and contribute equally. For migrant children who may feel isolated or different, this can be particularly beneficial. The opportunity to share elements of their own culture through activities can further promote inclusion and mutual understanding.

Enhanced Engagement: The use of technology such as FizziQ Junior can boost student engagement, which is especially crucial for migrant children who might otherwise struggle to connect with the subject material. The application of scientific concepts in real-world contexts makes the learning process more exciting and relevant.

Promotes Teamwork: By facilitating group activities, FizziQ Junior encourages teamwork and collaboration. This can help migrant children to integrate more easily into their new environments, enhancing social interaction and friendship formation.

Real-World Learning: The app allows for real-world application of scientific principles, fostering a deeper understanding of the subject matter. This practical approach to science education can be highly beneficial for migrant children, many of whom may have had limited access to hands-on science education in their home countries.
Cultural Exchange: Certain activities, like the "Colors, tunes, and smells from my homeland" activity, can serve as platforms for cultural exchange. Migrant children get a chance to share aspects of their culture, fostering a sense of belonging and understanding among diverse students.
Ease of Use: Despite potential initial unfamiliarity with technology, the app is easy to navigate and understand, reducing potential barriers to learning for migrant students.
Scientific Reasoning Skills: By using FizziQ Junior, students can develop scientific reasoning skills. For migrant children, this can help level the academic playing field and support their continued educational progress.

3.2. Pedagogical practices for using digital tools to teach IBSE

The reports provide several insights into suitable pedagogical practices for using FizziQ Junior to teach science:

Inquiry-Based Science Education (IBSE): Digital tools like FizziQ Junior are excellent tools for promoting this pedagogical approach, stimulating learning through questioning and problem-solving. It encourages students to form their own questions and explore answers through hands-on experiments. The versatility and number of instruments provided in FizziQ Junior allows students to address scientific interrogation from many different angles which makes the richness of the IBSE method.
Real-World Applications: Teachers have found success in linking the app's features to real-world scenarios, like measuring the noise levels in a school or the angles of bird nests. These connections makethe learning process more relevant and engaging for students. Teachers have reported that taking students out is always a rewarding moment. Tablets and smartphones are autonomous devices that can be taken anywhere and are even waterproof. Students should also encourage to take pictures to documenttheir findings.
Interdisciplinary Learning: The app can be used to bridge various subjects, such as integrating color studies in art class or using the geometry tool in math class. This approach enhances student understanding by showing how different fields of study are interconnected.
Collaborative Learning: Many teachers reported that their students worked effectively in groups when using the app. This practice promotes teamwork and communication, key skills in scientific collaboration. Digital tools provide a natural collaboration medium as information can be shared within the group, but also outside the group with parents or teachers.

Cultural Exchange and Inclusivity: The app can be used to facilitate cultural exchange and inclusivity, especially in classrooms with a diverse student population. Despoina's "Colors, tunes, and smells from my homeland" activity is an excellent example of this.
Differentiated Instruction: FizziQ Junior offers various features catering to different learning styles and abilities. Teachers can leverage this versatility to tailor their teaching to individual student needs. By creating their own activities, teachers can tailor reference activities to their own needs. They can also split the activities in different sequences and adapt them to their student's pace.
Active Learning: With the hands-on, interactive nature of the app, students are participants in their learning process, not just passive recipients of information. This method is known to increase engagement and retention.
Use of Technology: Incorporating FizziQ Junior in lessons offers students an opportunity to become comfortable with using technology, a skill that's increasingly important in today's digital age. Many students are addicted to games and they discover that smartphones and tablets can be used to do real science and document their findings. It also makes students comfortable in typing and develop their language skills. Finally, they can produce beautiful output in the form of PDF.
Continuous Feedback and Improvement: Teachers can use the app to provide immediate feedback to students, fostering a growth mindset and encouraging continuous improvement.
Curriculum Integration: The app can be effectively integrated into the existing curriculum, enriching lessons with its interactive features and real-world applications.

3.3. Onboarding teachers

Teachers who do not have a rich technological background are often suspicious with technology solutions. Technology should not be used everywhere but in many cases can help the teaching process, especially in science. During our final discussions, the following suggestions have been made to encourage teacherstest digital tools to teach IBSE and overcome their reluctance :

Promoting Inquiry-Based Learning: Highlight how FizziQ Junior fosters Inquiry-Based Science Education (IBSE), which stimulates learning through questioning and problem-solving. This approach has been proven to increase student engagement and understanding.
Sharing Success Stories: Publicize positive experiences from other teachers who have successfully integrated the app into their curriculum. This could be done through testimonials, case studies, or workshops where teachers share their experiences and ideas for using the app.
Providing Comprehensive Support: Teachers appreciate the support provided to help them get started with the app. Offering detailed tutorials, easy-to-follow guides, and prompt assistance can encourage more teachers to try the tool.
Showcasing Versatility: Demonstrating the wide range of applications and features of FizziQ Junior, such as the ability to create custom activities and link to real-world experiences, can encourage teachers to explore its use in their classroom.
Activities align with curriculum: Creating resources that are well adapted to countries curriculum is very important as teachers schedule is very busy during the year. A bank of activities should be created where teachers can add their own activities to be shared with colleagues around the world.

Highlighting the benefits for diverse classrooms: Many teachers found the app helpful in engaging migrant students, who could understand and operate it despite language barriers. Promoting these benefits can motivate teachers who work with diverse student groups.
Ensuring Technological Compatibility and Ease of Use: Emphasize the app's compatibility with various devices and its user-friendly interface, which many teachers praised.
Providing Opportunities for Professional Development: Organize workshops or training sessions on effective use of the app in the classroom. This not only helps teachers get comfortable with the technology but also counts towards their professional development.
Onboarding parents: Parents are an interesting relay for the teachers. Interesting parents to children education with apps that can be used at home motivates the learning process of children.

4. Conclusion

The goal of the project was to test if digital tools like FizziQ Junior could help migrant students learn science more effectively. The app was tested in 5 countries with 6 volunteers teachers whose class included migrant children. To suit teacher's needs, specific activities and training material was developed.

The reports show that the use of digital tools such as FizziQ Junior has proven to be very effective in teaching science to children, and especially to migrant children or children having disabilities, by providing a rich and engaging learning environment. These tools offer intuitiveness, ease of use, and enable the application of knowledge in real-world situations. They spark curiosity, enhance scientific reasoning, and promote teamwork and inclusiveness. With their versatility in accommodating various subjects and activities, they further stimulate learning.

The FizziQ Junior app has demonstrated its value in engaging students and making science accessible and exciting. Despite a few identified areas for improvement such as language availability, addition of more features and resources, it has successfully served as an interactive and inclusive learning platform. By fostering real-world application of knowledge, promoting teamwork, and facilitating cultural exchange, itoffers an enriching learning experience.

The application of appropriate pedagogical practices such as Inquiry-Based Science Education (IBSE), real-world applications, interdisciplinary learning, collaborative learning, and active learning is crucial in using digital tools effectively. By integrating these tools into the existing curriculum, teachers can encourage critical thinking, promote curiosity, and develop scientific reasoning skills in students.

To overcome initial reluctance in using digital tools, it's important to provide comprehensive support to teachers, sharing success stories, promoting the benefits for diverse classrooms, and providing opportunities for professional development. By highlighting the versatility and benefits of FizziQ Junior, teachers can be motivated to incorporate such digital tools into their teaching methodology. Furthermore, parents can also be engaged in the process, which can provide an additional motivational boost for students.

In conclusion, digital tools such as FizziQ Junior have a significant potential to improve science education for populations with specific needs, like migrant children. They offer unique opportunities for engaging, inclusive, and interactive learning experiences that extend beyond traditional classroom settings. By addressing the identified areas of improvement and employing suitable pedagogical practices, these tools can make science education accessible and exciting for all students, irrespective of their backgrounds.

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Appendix 1: More information on FizziQ Junior

Many different science activities can be conducted with FizziQ Junior. Among these are the following projects designed by the Fondation la main à la pâte, a partner of FizziQ :

1. Color: Through this activity, students will be able to compare and classify colors. They can analyze the colors of different objects in the world around them, characterize them using three primary colors and recreate them using a color synthesizer.
2. Sound: Hands-on offers two activities on the sound: the first allows students to understand what noise is and what the risks are associated with excessively loud sounds. The second proposes to the students to establish a sound level scale that they can test in their daily lives.
3. Where does the moss grow? : In this activity, the students can use the Luxmeter and Compass onthe app to test their hypothesis on why moss is often found only on one side of the tree trunk.
4. Measurements: Using the camera, students can reflect on what is a measurement, what is a ruler, a unit and how we can use the FizziQ measuring instrument to measure an object, or an animal such as an ant.

Further information on the FizziQ Junior app can be accessed on our website.

Appendix 2: Resources Available for the Teachers

- The FizziQ Junior Website
- The FizziQ Junior User Guide
- First Session with Students
    - A Step-by-Step Tutorial
    - A slideshow to guide the students.
- Guides for activities on FizziQ Junior
    - An Activity on Colors
    - An Activity on Sound
    - An outdoor activity on trees and light
    - The Compass Treasure Hunt: Navigating to Scientific Discovery!
    - Activity on the duration of day and night
    - Activity on the height of the sun in the sky
    - The sum of the angles of a polygon
    - Colors, tunes and smells of my homeland
    - Tubular melodies
    - Pythagorean Theorem
- Tutorial Videos prepared for the teachers

Appendix 3 : Teachers interview

summaryTeachers A

Teacher A's class of 14 students, composed primarily of migrants, engaged in an experiment on sound scale using FizziQ Junior. The application allowed them to use their tablets in a new and innovative way, taking measurements of various sounds in their immediate environment. The students analyzed a wide range of sounds - whispers, yelling, the ringing of the school bell, outside noises, and natural sounds - making diagrams with graphs on a scale of sound. This hands-on, interactive approach sparked curiosity and fostered a deeper understanding of sound volumes, noise pollution, and the potential harmful effects of excessively loud sounds.

Despite the language barrier, with most students being non-native English speakers, Teacher A found FizziQ Junior to be a highly intuitive and user-friendly tool. One of the standout features was the notebook's organization. It has various sections that facilitate learning scientific reasoning. This structure helped students see the logical sequence of scientific processes, thereby aiding their understanding and appreciation of science.

Teacher A recognized that FizziQ Junior promotes Inquiry-Based Science Education (IBSE), a pedagogical approach that stimulates learning through questioning and problem-solving. The integrated tutorial was another highlighted feature, which Teacher A found invaluable, guiding users step-by-step through the app's functions.

Based on the positive experience, Teacher A recommended the app to her colleagues and even planned a workshop on using FizziQ Junior effectively in a classroom setting. She found that the app made teaching science significantly more manageable, prompting her to continue using it in future experiments. Her students also suggested using the app in different contexts, like studying colors in art class, after exploring its various features.

Although her overall experience was very positive, Teacher A did have some recommendations for improvements. She suggested the addition of new instruments for measuring temperature, energy, and electricity to expand the app's utility across more scientific domains.

Teacher A experience showcased how effectively FizziQ Junior can help in developing a multidisciplinary teaching approach, bringing together aspects of science and technology in a student-friendly way. Even the typically noisiest students were focused and engaged during the sessions using the app, and it aided them in remembering the scientific concepts they learned. This highlights the app's role in enhancing student engagement and learning retention.

Teachers B

Teacher B, a teacher of a class of 12-year-old students, conducted three lessons using the FizziQ Junior app. The topics covered were a treasure hunt, the angles of a triangle, and the slope of a wheelchair ramp in the school. An additional lesson was initiated by a student who proposed a challenge to find the maximum noise level within the school.

Teacher B found that the app functioned smoothly on Android tablets and the instructions provided by the app were helpful for the students. A notable success was the geometry math tool. This aspect of the app facilitated students to grasp the concept of triangle angles in just 15 minutes - a task that would usually take an hour without the app.

The students showed great engagement with the real-world applications of their learning. They identified that the school ramps were too steep and addressed the issue with the school headmaster. This indicated the depth of their involvement with the lessons using the FizziQ Junior app, and highlighted the effectiveness of Inquiry Based Education solutions.

Teacher B found it easy to create QR codes to share activities and found the app to be a useful tool for Inquiry Based Science Education. However, he suggested that the app could benefit from a larger variety of activities. The students generally worked in groups, and there was no difference in learning between local students and migrant children from Ukraine.

Teacher B reported a positive overall experience and recommended the FizziQ Junior app to his colleagues.

Teacher C

Teacher C, teaching a class composed of 12 boys and 6 girls with half having writing or reading disabilities, found FizziQ Junior to be a valuable teaching tool. The app was used to study colors and numbers, as the rest of the features were too complex for the students. They ventured outdoors, utilizing two tablets and a phone, and used the app's color module to analyze the colors of nature.

Teacher C's students, who worked in groups, used the app to analyze and photograph colors of plants and flowers, and recreated them using the color synthesizer. The mathematical module was also intuitive for the students. The only challenge was language, as Slovakian was not available in the app. Teacher C suggested that the app would benefit from a module on learning the alphabet.

Despite the linguistic barrier, activities on nature proved to be an excellent fit for the children in Teacher C's class, composed entirely of migrant children including Ukrainian refugees and Romani people. Teacher C concluded her experience with an endorsement of more tablet usage in education, having seen the engagement and learning the FizziQ Junior app facilitated in her class.

Teacher D

Teacher D had a highly positive experience using FizziQ Junior in her classroom with 11-year-old students, some of whom are migrants from Russia, Albania, and Egypt. She found the video and guidelines provided by the app very helpful, and appreciated the ease of navigation and use.

She utilized the app in various activities, the most significant being the "Colors, tunes, and smells from my homeland" activity. This activity was conducted in groups, and the students loved using the features of the app, especially the ability to incorporate photos into their projects. They focused on music, colors, and took pictures of food items from their respective homelands, thereby facilitating a rich cultural exchange and fostering a sense of inclusiveness for the migrant children.

The students showed high levels of motivation and enthusiasm in using the technology. Teacher D was pleased to note that the app was very intuitive for the children, enabling them to use it instinctively after a brief demonstration. She had initially worried about potential glitches but was relieved to find that the app worked without problems.

Teacher D also wrote activities with a QR code, including one on food. She found the overall project to be well-organized, with the activities being easy to use and applicable to the learning objectives. Girls, as well as boys in her class, found the app interesting and enjoyed working with it.

Language was a concern for Teacher D since her students didn't speak English very well. She would have appreciated the app being available in more languages. However, despite this limitation, she noted the overall positive impact of FizziQ Junior in her classroom, especially for the migrant children who felt seen and cared for during these activities. The children were excited to talk about their countries and cultures, and the app gave them a platform to express themselves. Teacher D’s experience highlights how FizziQ Junior can enhance cultural appreciation and understanding in a diverse classroom setting.

Teacher E

Teacher E, a teacher of a class of 9-year-olds, used FizziQ Junior in a mainstream school with a high percentage of students needing special education. Many students in the class were from migrant children including children from Romani people population. Teacher E conducted two lessons using the app, one indoors and one outdoors. The outdoor lesson focused on bird life and measuring the angles of bird nests.

Despite a language barrier (some students spoke Ukrainian, while the app was in English), Teacher E reported that the students were excited and engaged in the activity. They were enthusiastic about the chance to use tablets for learning, highlighting the power of technology in the classroom. Teacher E found the activity creation process straightforward and praised the intuitive interface of the app, which made it easy for the students to use.

The outdoor activity was also well-received, and Teacher E noted that having an open notebook, rather than sequential questioning, posed no problems. Teachers appreciated the ease-of-use of the FizziQ Junior app, with time being a significant factor in their preference for straightforward tools. Student response to the app was very positive, with flexibility and the freedom of activities being highlighted as key advantages.

However, Teacher E suggested several areas of improvement for FizziQ Junior. She recommended that more languages should be made available on the app, given her diverse classroom. Other suggestions included delivering QR codes by email, a bank of pre-made activities, and the provision of school accounts. Despite these suggestions for improvement, Teacher E's overall experience with FizziQ Junior was positive, and she expressed that she would recommend the app to other teachers.

Teacher F

Teacher F found it easy to integrate FizziQ Junior into her teaching plan, using it for three lessons during April and May. She taught in a classroom with 30 students, 8 of whom were migrants. The lessons she conducted covered various subjects, including colors in English and a quest utilizing the compass function of the app, in addition to a music lesson.

Her students were delighted with the application, showing increased friendliness and team integration. They found the app easy to understand and navigate. The app was particularly helpful in improving students' understanding of scientific reasoning and familiarizing them with technology usage. Teacher F noticed that learning with FizziQ Junior became a game-like, fun experience for her students, which enhanced their learning process.

She encountered initial issues downloading the app on Android devices, but this was swiftly resolved with assistance. The QR code functionality of the app allowed her to create unique activities for her class. Olha also expressed a desire to explore other menus within the app, such as Position, Color Spectrum, Sun Moon, and Clock.

As a computer science teacher, she suggested the inclusion of a collaboration feature in the app to facilitate shared work. She reported no significant bugs or issues during her usage of the application. Based on her positive experience and the enthusiastic response from her students, Teacher F expressed a strong inclination to recommend FizziQ Junior to her colleagues, appreciating its easy usability and interactivity.

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