Inclusion of new arrived migrants in Science and Math: the Augmented Assessment approach

Inclusion dei migranti neoarrivati in Scienze e Matematica: l’approccio della valutazione aumentata

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ABSTRACT

This paper focuses on the inclusion of newly arrived migrants in Europe, reporting on the project “Augmented Assessment” (ERASMUS+/KA3). The project aims to narrow the assessment gap that results from barriers between those students and their teachers. The project’s theoretical orientations and the pedagogical approach guided the creation of an Augmented Assessment Training Course and Library. This paper explores primary and secondary teachers’ initial reflections and perceptions on piloting the proposed Augmented Assessment approach with newly arrived migrant students and how this approach could help them to perform a more inclusive assessment in Science and Mathematics. Results from the analysis of reflective diaries are presented and discussed in relation to existing international literature, and some initial conclusions are drawn.

SINTESI

L’articolo si concentra sull’inclusione dei migranti neoarrivati in Europa, riferendo del progetto “Augmented Assessment” (ERASMUS+/KA3), che mira a ridurre il divario di valutazione che deriva dalle barriere esistenti tra studenti e insegnanti. L’articolo esplora le riflessioni e le percezioni iniziali degli insegnanti della scuola primaria e secondaria in merito alla sperimentazione dell’approccio di valutazione aumentata proposto, e su come questo approccio potrebbe aiutarli a eseguire una valutazione più inclusiva in scienze e matematica. I risultati dell’analisi vengono presentati e discussi in relazione alla letteratura internazionale esistente e vengono tratte alcune prime conclusioni.

KEYWORDS: inclusive assessment, augmented reality, migrants, Science Education, Mathematics Education

PAROLE CHIAVE: valutazione inclusiva, realtà aumentata, migranti, educazione scientifica, educazione matematica
Introduction

Assessing students in summative and formative ways is a vital component of inclusive education. It coincides with UNESCO’s policy (2017) on learning assessment, which emphasizes the need to ensure effective and relevant learning for all students (Education 2030, Sustainable Development Goal). Yet, the implementation of inclusive assessment encounters specific barriers, particularly when the target population is migrant students who have recently arrived in the country. Assessment rules and processes that are monolingual are among the factors that contribute to these barriers. Several research studies have revealed that monolingual policies and practices have an influence on students’ test scores, especially in areas such as Science and Mathematics where assessing students’ knowledge is not strongly tied to language. Moreover, this lack of linguistic competence has a detrimental influence on students’ evaluation outcomes (Butler et al., 2004; De Backer et al., 2019; De Backer et al., 2017; Goodrich et al., 2021; Rivera & Stansfield, 2001). Research indicates that even multilingual second-language learners’ comprehension of Science and Mathematics is commonly understated when tests are given in the dominant language (Menken, 2010; Wright & Li, 2008).

Migrant students are described as newly arrived/first generation, second generation, or returning migrant children and youth. They may be citizens, residents, asylum seekers, refugees, unaccompanied children, or irregular migrants, depending on their motives for migration (e.g., economic or political). Their stay in the host country may be temporary or permanent, and they may or may not be permitted to participate in the formal education system of the host nation. It is also worth noting that migrant students are not characterized by uniformity. They have a wide range of features, including their language and cultural heritage, as well as the socioeconomic level of their families. Nonetheless, they might encounter similar obstacles to their successful integration into the school environment and realization of their academic potential (Eurydice report, 2019). The particular subgroup of recently arrived migrants has an even greater number of challenges, one of which is the lack of any record of their previous learning. Because of these factors, twenty-three of Europe’s education systems make a distinction between newly arrived migrant students and other first-generation migrants and second-generation students (attending school there for an extended period of time) (ibidem).

Monolingual practices and policies negatively impact newly arrived migrant students’ assessment; students, due to dearth of language proficiency, are not in a position to communicate their knowledge effectively to their teachers (e.g., De Backer et al., 2019). On the other hand, teachers feel unprepared to utilize innovative and inclusive approaches for assessing students’ prior knowledge in subjects such as Science and Mathematics (Eurydice report, 2019).

In attempting to address this issue, the Erasmus+/KA3 project “Augmented Assessment: Assessing Newly Arrived Migrants’ Knowledge in Science and Math using Augmented Teaching Material” proposes an approach to inclusive
assessment that combines the affordances of visual representations in the subjects of Science and Mathematics with inclusive pedagogy, multimodality and augmented reality. The project consortium is composed of the Aristotle University of Thessaloniki, the Polytechnic Institute of Porto, the University of Pompeu Fabra, the European University of Cyprus, the University of Helsinki, the Athens Lifelong Learning Institute, the Cyprus Pedagogical Institute, the Greek Institute of Educational Policy, and the Portuguese National Education Council, hence involving 5 different EU countries (Greece, Cyprus, Spain, Portugal, Finland).

Taking into account the foregoing, the project aims to increase opportunities for newly arrived migrant students (and other students with or without migrant backgrounds) to demonstrate their actual knowledge in Science and Math by using augmented reality and improving teachers’ understanding and pedagogical practices related to inclusive assessment. For accomplishing this aim, the Augmented Assessment Project has developed and piloted an innovative augmented toolkit – the Augmented Assessment Library, and The Augmented Assessment Teacher Training course for in-service Mathematics and Science teachers of upper primary and lower secondary school students (students’ ages 9–15). In the current paper, results from the analysis of the reflective diaries and from a pre-post questionnaire of the piloting of the Augmented Assessment approach will be presented and discussed.

1. Background

In order to assess the knowledge of newly arrived (and other) migrants and include them in their daily classroom activities, teachers appear to require new ways and resources to construct communication bridges. For overcoming this obstacle, the Augmented Assessment approach incorporates inclusive pedagogy, visual representations in Science and Mathematics subjects and augmented reality.

These concepts form the theoretical and practical foundation for what the partnership has termed an “Augmented Assessment Bridge” between students and their teachers. For a deeper understanding of the notion of “Augmented Assessment Bridge,” its different components are discussed throughout the next sections.

1.1. Inclusive assessment

Learning assessment uses a variety of methodologies and technologies to evaluate, measure, and document learning outcomes and progress. Through learning assessment, data from numerous sources about learners’ knowledge are gathered. These data provide teachers with valuable feedback on their students’ progress and achievement level and can inform their teaching practices. However, learning assessment does not constitute «an end in itself» (UNESCO, 2017, p. 3). Its objective, scope, object, or character is to improve fairness and learning for the persons, the communities and the societies (UNESCO, 2017). Particularly, the assessment of learners must adhere to inclusive pedagogy’s values as outlined in many definitions of inclusive pedagogy and inclusive education (Florian & Beaton,
2018). Still, according to Liasidou (2012), the terms and meanings related to inclusive education are fuzzy. For the scope of the Augmented Assessment project, inclusive pedagogy is defined as «an alternative pedagogical approach that has the potential to reduce educational inequality by enhancing learning opportunities for everyone» (Florian, 2015, p. 5).

1.2. Visual representations in the fields of Science and Mathematics

Visual representations are commonly used in Science Education to turn abstract scientific concepts into more tangible ideas, which helps students become more interested in Learning Sciences (Evagorou et al., 2015). Visual representations (e.g., symbols, drawings, pictures) with or without vocal information are often used in Science Education (Physics, Biology, Chemistry) to illustrate concepts or occurrences (Cook, 2006; Eliam & Poyas, 2010; Eliam & Gilbert, 2014; cited in Papageorgiou et al., 2017). Similarly, in Geometry, Statistics, Algebra, etc., visual representations are commonly employed to aid mathematical reasoning (Rau & Matthews, 2017). There are several possible forms of visual representation, since it is not a fixed concept. Moreover, depending on the teacher and the topic matter, several instructional techniques might use different types of visual representations (Soulios & Psillos, 2016; Tytler et al., 2018; Uchinokura, 2020). It is beyond the scope of this paper to discuss the different kinds of visual representations and approaches in more depth; what is important however to point out is that research suggests that contemporary learning in Science and Mathematics must align with multimodal learning (Abrahamson et al., 2020; Fernández-Fontecha et al., 2019; Yeo et al., 2020; Yeo & Nielsen, 2020).

1.3. Multimodality: Multimodal learning

Multimodality emphasizes the range and plurality of modalities that humans employ for producing, expressing, disseminating, and conveying meanings (Bezemer & Jewitt, 2010). Image and writing, speech and gesture, math symbols and writing, and so on, are never separated but usually occur together. When researchers first coined the term “multimodality,” they were attempting to emphasize the necessity of researching how multiple forms of meaning creation are merged into a unified, multimodal whole (Jewitt et al., 2016). Multimodality is perceived from a social semiotics viewpoint (Van Leeuwen, 2008). Given this perspective, “mode” refers to culturally and socially constructed meaning-making resources (Kress, 2019). Significant forms of meaning include verbal, visual, aural, gestural and spatial (New London Group, 1996). These modalities have unique and distinct affordances (Kress, 2019).

Different modes have different meaning-making potentials. Modal affordances affect the sorts of semiotic work a mode can accomplish, its simplicity of use, and the number of ways it can execute similar semiotic tasks. Modal affordances are tied to the mode’s material and social history, or its social roles in a given setting (Jewitt et al., 2016). Hence, meanings rely on many forms and media (Kress & Van
Leeuwen, 2020). Media denotes meaning-transmission in this context (e.g., a computer screen).

Hence, realizing meanings through modes and media is a crucial component of communication, as the Augmented Assessment project has recognized since its inception. However, multimodality’s relationship to technology is important in current/contemporary learning contexts, especially as augmented reality can be defined as multimodal technology.

1.4. Augmented reality in Science and Mathematics Education

In recent years, augmented reality (AR) has sparked the interest of educators and educational researchers in the field of education. A thorough literature study by Garzón and colleagues (2019) documents the significant growth in educational usage of augmented reality and augmented reality applications. AR is a recent, quickly advancing technology that is utilized in a variety of businesses and areas, such as education, advertising and industry, and technical training. AR is a cutting-edge technology in advertising, manufacturing, technical training, and education. AR lets users interact with the real environment using digital data. Digital elements linked to a place or image give virtual information that overlaps the actual world. AR can display text, photos, movies, and 3D figures with motion and sound. AR immerses users in a physical-digital world. It also lets users engage with digital data, which enhances their sense of active involvement in this world (Azuma et al., 2001; Craig, 2013).

In Science Education, AR’s affordances to scale virtual things helps students to learn their qualities and relationships through “interaction” and object handling. In students’ daily lives, these items would be too little or too huge to address properly (Yuen et al., 2011). AR has been used in different Science subjects such as Physics (Akçayır & Akçayır, 2017; Chen, 2006; Sofianidis, 2022), Chemistry (Cai et al., 2014; Néchypréncen et al., 2018; Núñez et al., 2008) and Biology (Tarng et al., 2015). AR books have also been used to engage students in science concepts and phenomena (Dünser et al., 2012; Sahin & Yilmaz, 2020). In Mathematics Education, researchers have utilized AR to explore geometrical concepts (Flores-Bascuñana et al., 2020; Kaufmann, 2004; Rossano et al., 2020) as well as probabilities (Cai et al., 2019).

Notwithstanding variances in methodology, sample, participants, locations, and goal of using AR in the aforementioned studies, it can be inferred that AR in Science and Mathematics Education provides various benefits, including increasing students’ motivation for learning and understanding. Yet, like any revolutionary technology, it is not devoid of certain obstacles and prerequisites. The educational benefits of AR can only be realized if challenges preventing its effective use are acknowledged and addressed, and certain conditions are met. These challenges include teachers’ limited time to learn AR technologies, limited financial resources, students’ frustration if they cannot use an AR application or if it does not work, the disruption of students’ learning caused by image information when it is first presented, and the dearth of support and professional development opportunities for
teachers (Meletiou-Mavrotheris et al., 2019). As with other educational technological advancements, this new technology is insufficient in and of itself. The effectiveness of the implementation of current technology in the classroom relies on the educators who actually use it (Koutromanos & Mavromatidou, 2021). By adopting this perspective, the motivation for conceptually and practically developing the notion of “Augmented Assessment Bridges” is not limited to utilizing the innovativeness of AR, but also perceiving it as a pedagogical bridge between students and teachers.

### 1.5. Augmented Assessment Bridges

Augmented Assessment Bridges in the context of the Augmented Assessment project use AR affordances to create multimodal, powerful, dynamic representations of mathematical and scientific concepts that overcome language barriers and may be used for inclusive assessment. Hence, Augmented Assessment Bridges integrate visual representations, multimodality, and AR affordances within inclusive education. AR affordances make visual representations more dynamic, powerful, and inclusive by enabling numerous modes, resulting in augmented multimodal representations. Augmented Assessment Bridges are multimodal, inclusive pedagogy-based representations.

An Augmented Assessment Bridge is a multimodal representation (3D modal, 3D or 2D animation, video, etc.) that transmits a physical fact, notion, or idea of Science or Math between instructors and students without the necessity for spoken communication. Adopting the idea of the Augmented Assessment Bridge could help teachers and students to communicate regarding assessment purposes, as what is created is a space that allows and encourages migrant students to share their knowledge in a mutually inclusive manner.

Additionally, for the scope of the project, while Augmented Assessment Bridges were created to help educators overcome the linguistic barriers of newly arriving migrant children, they might benefit all students.

Within this frame of thought, the Augmented Assessment Teacher’s Training course aims to provide teachers with theoretical and practical knowledge and skills that will empower them to incorporate AR in their teaching practice by utilizing augmentation tools and resources (created by other teachers or by the partnership as good practice examples) that are available on the project platform.

Additionally, the course aims at engaging teachers themselves in the creation of new Augmented Assessment Bridges (augmentation) through an inclusive, multimodal lens that aligns with their own needs.

For developing the course’s pedagogical and didactic approach, elements from Technological Pedagogical Content Knowledge (TPACK) (Mishra & Koehler, 2006), Communities of Practice (Lave & Wegner, 1999), Professional Learning Communities (Hargreaves & Fullan, 2015) as well as key principles of adult education (Kamışlı & Özonur, 2017) were considered. More information about the
theoretical foundations of the course can be found in Sofianidis and colleagues (2022).

2. Methodology

In the methodology section, the context of the study (including information about the training course and the Augmented Assessment Library), the participants and the collection and analysis of the data will be presented.

2.1. Context of the study

2.1.1. Master Training Event

Since the project is still in the piloting phase in four countries (Finland, Cyprus, Portugal, and Greece), the Augmented Assessment training course was fully implemented during the Master Training Event (MTE).

This paper focuses on the piloting of the training course in the form of a Master Training Event and the ongoing piloting phase in four countries.

Ten teachers from all the participating countries (three from Greece, three from Portugal, one from Finland, and three from Cyprus) were trained during the MTE on all the aspects of the approach to become Augmented Assessment Trainers and returned to their home countries to implement a small piloting phase with a small group of migrant students from their schools.

The training included the following modules available on the project’s Moodle platform:

- Module 1 – Augmented Assessment: ways in which the augmentation of the assessment material supports the inclusive assessment of newly arrived and other migrants;
- Module 2 – Pedagogical Framework: students’ knowledge in Math and Science, Formative and Summative Assessment in Science and Mathematics Education, Multimodality and Augmented Reality as a means to inclusive assessment;
- Module 3 – The Augmented Assessment Library: how to use the Augmented Assessment Library to assess newly arrived and other migrants’ knowledge in Science and Mathematics to foster their inclusion;
- Module 4 – Creation of Augmented Assessment material: how teachers can create their own Augmented Assessment material based on their context needs. This module includes the guidelines for teachers to create Augmented Assessment items;
- Module 5 – Creative formative assessment: how to take advantage of the Augmented Assessment results through creative assessment methods using AR and multimodality;

2.1.2. The Augmented Assessment Library

The Augmented Assessment Library is the project’s key innovation¹. The product’s novelty rests in the fact that it is the first open educational resource to include Augmented Assessment Bridges (augmented multimodal questions) in Science and Mathematics Education that teachers may use to gauge their students’ understanding. This resource is available in several languages.

The Augmented Assessment Library is a user-friendly platform created to meet the needs of teachers. As its design approach takes into account and combines recent innovations in AR, formative and summative assessment, and inclusive education with a focus on migrant students, it could be a potent and effective tool for educational practitioners.

The Augmented Assessment Library is built around the advantages of AR, especially its multimodal and interactive elements. Its major goal is to provide teachers with augmented questions – augmented illustrations of scientific and mathematical ideas and phenomena. In more simple terms, augmented questions are interactive, visual representations made possible by software and AR tools.

¹ https://ildeplus.upf.edu/augmented_assessment.
Teachers can use the Augmented Assessment Library to assess their students’ knowledge by selecting questions developed either by the consortium or by participating teachers. Once teachers pick items, the library generates a document with trigger images, codes, and responses.

Students scan a trigger picture or code to watch a video or 3D animation of a question. Students watch the augmented question and fill out an answer sheet. Their teachers can grade the sheet when they finish.

The Augmented Assessment Bridges can thus assist teachers in assessing migrant students’ preexisting knowledge on the selected components of knowledge and adjust their instruction to each student’s needs before they start attending school in the host country.

They can also be used as a formative assessment or alternative conception investigation before teaching a topic. In the project, teachers get trained to create their own representations².

After the Augmented Assessment implementation in their classrooms, teachers can better understand their student’s knowledge and find a new approach to communicate with them.

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² The training material will be available on the project site: https://augmented-assessment.eu/.
Since the Augmented Assessment Bridges have no linguistic boundaries, instructors across Europe and the world will contribute to the Augmented Assessment Library to establish a collection of augmented questions in the above fields. This will help teachers assess their students’ Science and Math knowledge (including newly arrived and other migrant students’ knowledge) by constantly providing them with useful and practical resources.

Teachers currently do not have access to such resources or to a collective space to create and access them. The Augmented Assessment Library and Augmented Assessment Bridges (assessment material) can be utilized in any country, regardless of the host education system’s language or migrant students’ linguistic background, even though this initiative is taking place in the European Union.

2.2. Participants

Ten teachers coming from all the participating countries (three from Greece, three from Portugal, one from Finland, three from Cyprus) were trained during the Master Training Event in all the aspects of the approach to become Augmented Assessment Trainers.

Four of the participant teachers were Secondary teachers with Major in Mathematics (2) and Science (2), and six of them were General teachers (three of them with expertise or specialization in Mathematics). Teachers described their level of familiarity with technology as intermediate (5), advanced (4) or expert (1).

2.3. Data collection and analysis

After the MTE, the participants were asked to use the material from the Augmented Assessment Library with newly-arrived and other migrant students from their classrooms or schools as a small pilot of the approach in real-classroom settings, and to keep reflective diaries using Rolfe and colleagues’ (2001) framework, which focuses on three questions:

- What?
- So what?
- Now what?

For the analysis of the reflective diaries, we used qualitative content analysis, following a grounded theory approach (Strauss & Corbin, 1990). We used open coding, in a process of «breaking down, examining, comparing, conceptualizing and categorizing» qualitative data/texts (1990, p. 61); this process of coding yields concepts, which are later grouped and turned into categories.

This has allowed us to systematize the experiences, reflections, risks, advantages, and recommendations of the educators involved in the small piloting.

Five major categories emerged from the analysis: students’ motivation and involvement; pedagogical diversity; effectiveness of the proposed methodology; positive and negative aspects of the small piloting and methodology; recommendations for improvement and future small piloting.
3. Results

In what follows, the findings gleaned from the reflective diaries regarding each of the aforementioned categories will be presented to shed light on the perspectives, recommendations, and challenges the teachers had based on their experience in using the Augmented Assessment approach.

3.1. Students’ motivation and involvement

The potential of integrating educational technologies, associated with multimodal representations and augmented reality, to improve students’ motivation, to make learning more enjoyable and interesting has been indicated by the teachers in the reflective diaries (Table 1). This was recognized by all teachers, regardless of their level of comfort with and ability to use AR and/or to create multimodal representations for their classes.

<table>
<thead>
<tr>
<th>Students’ motivation and involvement</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engagement</td>
<td>The students who participated in this pilot study seemed engaged and interested in this new method of assessment, and they were happy to participate in this intervention. (CYP01)</td>
</tr>
<tr>
<td>Interest</td>
<td>The tools’ visualization made them feel confident and engaged them to show more interest in the lesson. (CYP02)</td>
</tr>
<tr>
<td>Motivation</td>
<td>All five participating children were excited while noticing the static pictures being transformed into an animation. (CYP03)</td>
</tr>
<tr>
<td>Confidence</td>
<td>The students were really engaged in this unique learning experience, and they couldn’t wait to scan the code of the next augmented problem. (CYP03)</td>
</tr>
<tr>
<td>Engagement</td>
<td>They shared their enthusiasm with the rest of their classmates, and they were all wondering when they were going to use it again. (CYP03)</td>
</tr>
<tr>
<td>Interest</td>
<td>Students feel more motivated when using ICT combined with new and enriching experiences. (PRT01)</td>
</tr>
<tr>
<td>Motivation</td>
<td>I learned that students feel more motivated to learn when using ICT, especially if they are not accustomed to new, different and enriching experiences. (PRT02)</td>
</tr>
</tbody>
</table>

The experience also allowed some teachers to overcome the hesitancy in using technological devices in the classroom, as reported: «at first, I encountered a sort of hesitation in giving five tablets (one to each student), my experience showed that newly arrived students are as capable as other young students in using technology."
Their familiarity with QR codes and their knowledge of how to scan them was amazing. The latter was something I couldn’t predict \textit{a priori}.

### 3.2. Pedagogical diversity

Teachers also recognized the experience as a valuable way to diversify the assessment methods they use and the inputs that diversity brings to student involvement and motivation. The Portuguese especially seem to highlight that issue more than their colleagues in other countries (Table 2).

<table>
<thead>
<tr>
<th>Pedagogical diversity</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedagogical diversity fosters student motivation and learning</td>
<td>This activity reinforced the idea that I already had about the importance of diversifying methods and resources to captivate students’ attention and interest, and thus help improve their learning skills. (PRT01)</td>
</tr>
<tr>
<td>Pedagogical diversity improved in class</td>
<td>I learned to diversify pedagogical methodologies and practices. (PRT02)</td>
</tr>
</tbody>
</table>

**Table 2 – Pedagogical diversity**

In the reflective diaries, teachers referred to the effectiveness of the approach proposed by the project, noting that, in most cases, the students were able to understand the concepts presented in the Augmented Assessment Bridges (Table 3).

<table>
<thead>
<tr>
<th>Effectiveness of the proposed methodology</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students were able to understand the content of the questions</td>
<td>They were all able to understand the mathematical content of the problem and choose the correct answer. It was an interesting experience both for me and the students. (CYP03)</td>
</tr>
<tr>
<td>The methodology is promising for newly arrived migrants</td>
<td>This teaching experience indicates the effectiveness of augmented mathematics problems as tools to support and evaluate newly arrived migrants’ knowledge of mathematics. While the traditional methods of instruction might not be informative enough as far as the cognitive progress of migrant children is concerned, augmented reality appears as a promising alternative in classroom practice. (CYP03)</td>
</tr>
<tr>
<td>Students were able to understand</td>
<td>The method used was sufficient, and the procedure run smoothly. (GRC01)</td>
</tr>
</tbody>
</table>

\(^3\) (CYP03).
I better understood the importance of evaluating the students based on their educational level and not their age, as none of the students, not even student A who is in the 11th grade, answered all the questions correctly. Based on the class they are in, the students should know the correct answers. However, by placing them in a class based only on their year of birth and nothing else we deprive them of the right to knowledge because if they do not understand the language their learning remains stagnant. (GRC01)

One of the teachers (GRC01) has also pointed out that the methodology has allowed a clearer understanding of the students’ real prior knowledge, which can be used to differentiate instruction and support students by overcoming language barriers.

Another teacher recognizes that the procedure facilitates the integration of migrant students in the class: «In such a way, the children will at least acquire the core knowledge of the lesson, and therefore it will be easier to integrate them with the rest of the class»4.

### 3.3. Positive and negative aspects and recommendations for improvement

In the reflective diaries, the teachers were also asked to point out the upsides, on top of the previously identified ones, and downsides (positive and negative aspects) of the small piloting and the approach.

A summary of the aspects pointed out is presented in Table 4.

<table>
<thead>
<tr>
<th>Positive aspects of the small piloting</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Involvement of students</td>
<td>The students reacted positively to the experience and the whole process went smoothly. During the pilot trial, we had the opportunity to observe the difficulties of the students in real-time, and thus we will be able to optimize the process. (GRC01)</td>
</tr>
<tr>
<td>Involvement and cooperation among students; Rewarding small piloting</td>
<td>It was enriching and very rewarding to see the commitment, interest, mutual help, and sharing between students in order to successfully solve the task. (PRT02)</td>
</tr>
<tr>
<td>Opportunity to extend the small piloting and</td>
<td>This can be applied with all types of students and that everyone can learn from it. (PRT02)</td>
</tr>
</tbody>
</table>

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4 (CYP02).
Students liked the questions
In the student’s opinion the questions were good. (FIN01)

Involvement and cooperation among students
Commitment/interest/inter-help/sharing in students. (PRT01)

As it can be seen in teachers’ responses, on top of the aforementioned educational benefits of the small piloting and methodology, the teachers highlighted the positive involvement of students and the environment of mutual help and cooperation that was created in the classroom, the richness of the small piloting and the possibility to extend the small piloting to other students.

### Table 4 – Positive Aspects of the Small Piloting

<table>
<thead>
<tr>
<th>Negative aspects of the small piloting</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dealing with new technologies and/or devices</td>
<td>Difficulty in the level of technology (not all tablets could read QR codes, and it was necessary to install the application in them); in addition, I had to use my phone and my personal tablet so that all students could perform the activity. Once these difficulties were overcome, the following activities took place in a more peaceful way, and it was possible to verify more satisfaction and less frustration in the students. (PRT02)</td>
</tr>
<tr>
<td>Dealing with new technologies and/or devices</td>
<td>At the beginning of the pilot test, a little difficulty was observed in understanding how to scan each QR code and what to do with it next. In particular, student D showed difficulty in understanding what he had to answer and how to express his answer on the worksheet given to him. (GRC01)</td>
</tr>
<tr>
<td>Readability issues in mobile devices</td>
<td>Student D appeared to have difficulty seeing the information on the mobile screen and often brought it close enough to his face to see. (GRC01)</td>
</tr>
<tr>
<td>Dealing with legislation concerning the use of mobile devices</td>
<td>There were also issues with reading the QR codes on the students’ devices. In our school (and in many others) we are not allowed to download or ask students to download anything without their parents’ supervision. (FIN01)</td>
</tr>
<tr>
<td>Dealing with new technologies and/or devices</td>
<td>Difficulty in technologies, not all mobile phones could read QR codes, and it was necessary to help students at this stage coping with possible technical issues. (PRT01)</td>
</tr>
</tbody>
</table>

### Table 5 – Negative Aspects of the Small Piloting
On the negative side, it is mainly the technological issues that have posed some barriers during this small-scale piloting of some of the questions included in the Augmented Assessment Library. Teachers mentioned that it was difficult to manage the scanning of QR codes, mainly because it was necessary to install additional software on the devices, which caused some delay and confusion. There is also a mention of readability issues in small screens, which led at least one student to the need to bring the device closer to his eyes. Teachers also made several recommendations for improvement based on the knowledge they gained during the small piloting in the different multicultural contexts, which we summarize in Table 6.

<table>
<thead>
<tr>
<th>Recommendations for improvement</th>
<th>Verbatim</th>
</tr>
</thead>
<tbody>
<tr>
<td>The physical arrangement of the classroom</td>
<td>Students need to be distanced from each other, especially when students speak the same language, so that they cannot exchange answers and there can be meritocracy during the process. (GRC01)</td>
</tr>
<tr>
<td>More detailed instructions on how to implement</td>
<td>Considering that the students to whom the program is addressed may not understand the language we speak at all and cannot communicate with us sufficiently, each step must be more detailed and clearer. (GRC01)</td>
</tr>
<tr>
<td>Improvement of the answer sheets</td>
<td>The way the worksheets were structured where only the number of the answer was given and the boxes where the students had to mark an X or a tick seemed to make it difficult for the students. (GRC01)</td>
</tr>
<tr>
<td>More detailed instructions on how to implement</td>
<td>It might be useful to make an introductory video that will explain with pictures the whole process that needs to be followed. Such a video should consider the different ways in which QR codes are scanned by different software (Android, iPhone), as students who did not use their personal mobile phones for the process had difficulty finding the way to scan. Also, in the video, it could be shown that they can watch the video again as many times as they want and that they can take notes on the paper given to them as these were not directly understood by all the students. (GRC01)</td>
</tr>
<tr>
<td>Use of bigger screens</td>
<td>Students who have difficulties or vision problems may find it difficult to watch the video on a screen the size of a mobile phone. Therefore, for students with such concerns, it would be better to use tablets that have a larger viewing screen. (GRC01)</td>
</tr>
<tr>
<td>Improvement of answer sheets</td>
<td>Maybe the possible answers should be written on each worksheet, as they appear in each video. As it was time-consuming for the students to go back and forth on the video to compare answers, but also involved the risk of</td>
</tr>
</tbody>
</table>
Making mistakes when copying from the video to the paper. (GRC01)

Table 6 – Recommendations for Improvement

Regarding the implementation of the small pilot, the teachers believe it would be beneficial to receive more detailed instructions, both for students and teachers, on how to access and interact with the printed materials, digital content, and technologies. This could help in reducing the learning curve and any initial disturbance in the first contact with the procedure. A recommendation for using bigger screens could also be included here if needed. Improvements in the answer sheets are also recommended to provide a better way for students to register their answers and to visualize a summary of the answer options.

Discussion and conclusions

The small piloting of the approach and the teachers’ reflection on their experience seem fruitful, since the analysis of the reflective diaries revealed several interesting results. On the one hand, teachers pointed out several positive aspects of the Augmented Assessment approach that could give us the right to characterize the approach as at least promising and, on the other hand, highlighted challenges that they faced and could be setbacks for future implementations.

The approach is based on the affordances of multimodality and augmented reality technologies that seem to motivate the students who participated in the small piloting. The enhancement of students’ interest and engagement as a result of using augmented reality technologies to teach or assess Math and Science concepts witnessed in this study concurs with the literature (Akçayır & Akçayır, 2017; Garzón, 2021; Sofianidis, 2022). These results, combined with the fact that students seemed to understand the concepts behind the Augmented Assessment Bridges, and with the observed increase in students’ confidence, empower the idea that the use of these visual representations could provide the solution for a more valid assessment of newly arrived migrants while, at the same time, also helping them to become more interested in learning Science and Mathematics (Evagorou et al., 2015). Additionally, teachers found the approach attractive and suitable to be used not only with the target group of newly arrived migrants, but with the whole classroom. Teachers recognized that the approach could also be helpful for all students, including students with disabilities and other educational needs. At the same time, findings underlined some challenges of the approach that focus mainly on technological issues, such as the need for reliable mobile devices, the need to prepare the device by installing the app, better performance on big screens (tablets), etc., and the need for clearer instructions on how the approach can be applied. In most cases, teachers noted that despite the technological challenges, the approach was implemented smoothly and gave them fruitful results.

Although this was the first attempt to implement the approach in real-life settings with newly-arrived and/or other migrant students in a small-scale pilot...
implementation, the results indicate that the approach works and fulfil its goal of offering a new and more valid and inclusive way of assessing newly-arrived and other migrant students’ knowledge, in order to foster their inclusion in education. Future classroom implementations of the approach by teachers currently participating in the pilot testing of the training course in four partner countries will provide rich data that will enable us to conduct an in-depth assessment of the effectiveness and added value of the approach.

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