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ARETE – DELIVERABLE (D5.1)

"WP5 - D5.1: Analysis of PBIS Requirement for ARETE"

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Executive Summary

The "Analysis of PBIS requirements for ARETE" report, addresses the capture and definition of requirements for the development of Augmented Reality (AR) for a system of teaching values and behavioural expectations within the framework of Positive Behaviour Interventions and Support (PBIS).
This deliverable describes how we have explored for the first time the opportunity of converging augmented reality with behavioural teaching and learning within the preventative proactive approach of PBIS. The report lays the foundations for introducing AR into a new teaching and learning context that has human behaviour as a teaching subject through PBIS.

The report describes the research and development activities aimed at: 1) identifying the research gaps within the state of the art and 2) constructing scenarios for the use of the application with the identification of requirements and specifications of the AR objects to be developed (Task 5.1). For the implementation of Task 5.1, focus groups were held with teachers of PBIS primary schools and PBIS-experts with the aim to identify a set of specifics for designing AR objects for the PBIS-AR application. The focus groups were specifically aimed at capturing a collection of behavioural scenarios, situations, procedures, and/or routines typical to students' everyday school life needed for the implementation of the PBIS-AR application.

Subsequently, the most common PBIS school values were identified based on a scoping review of the research literature, the ideas of PBIS-experts and teachers, and a range of expectation matrices developed around the world. Based on these school values, a longlist of behavioural expectations was identified and grouped into a behavioural expectation matrix for ARETE. A reduction of this longlist was undertaken to define a set of 15 expected behaviors and/or procedures/routines useful for the development of scenarios to be implemented in the PBIS-AR app.

In order to define the final set of ARETE PBIS behavioural expectations, further input from stakeholders (i.e., teachers and students) was obtained. The planned focus groups could not be executed due to the COVID-19 pandemic and an online questionnaire regarding the state of the art of PBIS education in Europe (i.e., the PBIS in Europe or PBIS-E questionnaire) was administered to teachers and students from European PBIS schools. The questionnaire was mainly intended for the 1) validation of the shortlist of the above mentioned 15 behavioural expectations, and 2) the validation of the effectiveness of potential reinforcement systems for appropriate behaviour in students that will be used in the PBIS-AR application.

Moreover, a set of scripted behavioural lessons were designed by using the Lesson Study methodology in which small teams of teachers collaboratively worked in designing and developing the lesson series (Task 5.2) and the sequence of examples and nonexamples of appropriate behaviour necessary as input for the behavioural routines to be designed for the AR animations in the PBIS-AR app.

The report also includes activity of task 5.2 related to the design of the pilot 3 for validating these innovative teaching scenarios and studying the effect on students' social skills and regulatory behaviour. Additional activities were carried out concerning ethical and GDPR compliance within Pilot 3 of ARETE project.

1. Introduction

The aim of this report is to capture and define the requirements for the development of Augmented Reality (AR) for teaching values and expectations within the framework of Positive Behaviour Interventions & Support, abbreviated as PBIS. The report describes the research and design process aimed to identify a set of values and expectations to be addressed by the PBIS-AR application as a tool to support students' learning of shared values and expected behaviour within the well-validated Schoolwide Positive Behaviour Intervention and Support (SWPBIS) framework with the aim of promoting their self-management and self-regulatory skills in school settings.

A brief overview of PBIS in school settings is provided to help readers better frame the theoretical framework guiding the development of the AR-solution for Pilot 3.

Following this introductory note, the report focuses on:

1. The identification of PBIS content and requirements that guide the development of the PBIS-AR application;
2. The results of a scoping review addressing the state of the art of interventions integrating AR solutions to teach/train behavioural social skills;
3. The description of Lesson Study, as the methodology followed to design a series of behavioural lessons that target the awareness of expected behaviour and the acquirement of self-management and self-regulatory skills needed in PBIS-settings;
4. The description of the requirements for Pilot 3 in terms of research design (design, participants, measures, assessment, and intervention strategy).

2. Positive Behavioral Interventions and Supports (PBIS): A description of the framework

This section describes what the framework of PBIS entails. When the framework is applied in schools, it is usually depicted as SWPBIS. The broader context in which this preventative mental health framework is situated is also sketched, as to better pinpoint the educational landscape we are moving in. Last but not least, SWPBIS is more defined and the context in which explicitly teaching behavioural expectations as universal primary tier interventions is described. The direct teaching and practicing of behavioural expectations will be the content of the AR solution of this WP5.

2.1. Introduction

School safety, student behaviour, and academic outcomes are priority areas to be addressed in educational agendas (McEvoy & Welker, 2000). Challenging behaviour presents a barrier for learning (Chitiyo et al., 2011), contributes to poor school climate (Ögülmüs & Vuran, 2016), negatively impacts students' quality of life (Emerson et al., 2014), adversely affects peers (Dishion & Tipsord, 2011), and contributes to teacher burnout (Brunsting et al., 2014). Schools are responsible for (a) creating safe, positive, and meaningful learning environments for their students and (b) adopting approaches that respect students' academic and behavioural needs to promote student success.

Over the last decades, schoolwide frameworks, like SWPBIS have emerged to support student behaviour and create safe learning environments (Greenwood et al., 2008). SWPBIS supports schools in (a) creating systems that establish a positive social culture, (b) implementing a continuum of evidence-based practices to support student behaviour and promote a safe learning environment, and (c) using data to monitor and adjust implementation (Sugai & Horner, 2009a). The adjective "positive" refers to both behaviour and support: Positive behaviour, which can be seen as desirable, adaptive, prosocial behaviour. And positive behavioural support as differentiated from nonpositive support, which might involve the use of aversive, humiliating, or stigmatizing interventions (Dunlap et al., 2014).

When SWPBIS is implemented with fidelity, students, educators, and schools experience positive outcomes, including increased prosocial skills (Bradshaw et al., 2012), enhanced perceptions of school safety (Horner et al, 2009), reduced problem behaviour (Bradshaw et al., 2012; Waasdorp et al., 2012), improved school climate (Bradshaw et al., 2008; Bradshaw et al., 2009; Horner et al.,

2010), and increased teacher self-efficacy (e.g., Kelm & McIntosh, 2012) and well-being (e.g., Ross et al., 2012).

2.2. Schoolwide Approaches: SWPBIS, RtI and MTSS

Three prominent schoolwide frameworks are often mentioned in the literature to support students' behavioural and cognitive growth: Multi-Tiered Systems of Support (MTSS), Response-to-Intervention (RtI), and SWPBIS (Nelen, Pinatella, & Simonsen, under review). All three frameworks are based on a public health prevention model and employ three tiers of support (Bohanon et al., 2016). The first tier includes primary interventions that are provided to the entire school population. The second tier focuses on individuals or groups of students with common needs, and the third tier provides individualized treatments. Freeman et al. (2017) considered MTSS as an overarching framework aimed to improve academic and behavioural outcomes for all students. They distinguished three core features of MTSS: (1) data-based decision making, (2) use of evidence-based practices, and (3) support systems to maximize implementation fidelity. Universal screening is used to identify risk proactively (Briesch et al., 2019), and there is an integrated progress monitoring to identify and adjust interventions to student need (Sanetti & Luh, 2019).

Bohanon et al. (2016) defined RtI as the practice of providing high quality instruction and interventions matched to student need, while (a) frequently monitoring progress to adjust instruction or goals and (b) regularly screening to identify students who require additional support to be successful. Initially, RtI emerged as an alternative approach to the traditional discrepancy model for identifying students with learning disabilities (Sugai & Horner, 2009b). Subsequently, the focus expanded into a general approach for improving instructional and intervention decision making for all students (Sugai & Horner, 2009b).

SWPBIS is a framework for implementing evidence-based practices to support students' social, emotional, and behavioural growth. SWPBIS focuses on building social and other functional competencies, creating supportive context, and preventing the occurrence of problem behaviour (Kincaid et al., 2015). SWPBIS practices include establishing and explicitly teaching schoolwide behavioural expectations, systematically acknowledging desired student behaviour, effectively and equitably responding to challenging student behaviour, and using behavioural data to identify students who require additional support and enhance implementation (Nelen et al., 2019). Contextual fit—that is, adjusting SWPBIS to the context it is implemented in—is crucial for successful implementation (McIntosh et al., 2010).

There are different perspectives on how the newer use of the term MTSS emerged, and the framework names are sometimes paired (e.g., SWPBIS/MTSS) or used interchangeably (e.g., MTSS is an evolution of RtI) (Nelen, Pinatella, & Simonsen, under review). For example, Charlton et al. (2020) stated that MTSS grew out of two parallel approaches, i.e. RtI and SWPBIS, to support students' academic and behavioural needs respectively. Whereas Sanetti and Luh (2019) declared that MTSS was formerly referred to as RtI, McIntosh and Goodman (2016) stated that the MTSS model is not simple the implementation of both RtI and SWPBIS systems, but a systematic and careful integration.

For the purpose of this report, both SWPBIS and RtI are defined as examples of MTSS. Both focus on prevention, building a schoolwide multi-tiered continuum of support. Both use evidence-based interventions, regular screenings for early intervention, problem-solving models and data-based decision rules, focus on teaming, and have an emphasis on improving the quality of implementation (Nelen, Pinatella, & Simonsen, under review). Both frameworks are embedded into the school improvement plan (McIntosh & Goodman, 2016). Despite these similarities, the following differences need to be mentioned: RtI focuses on academic assessments and interventions, SWPBIS on social behaviour. For RtI, Tier 1 targets the core curriculum, whereas Tier 1 in SWPBIS consists of schoolwide, universal interventions for all students. RtI contains periodic and direct assessments of skills through benchmarking periods. SWPBIS employs universal screening of social-emotional-behavioural strengths and needs, and also assesses social behaviour continuously through existing data sources (e.g., disciplinary contacts, attendance). RtI focuses on grade level teaming, SWPBIS on schoolwide teaming (McIntosh & Goodman, 2016).

2.3. SWPBIS more defined

SWPBIS is not a curriculum, intervention, or program. It is an approach designed to improve the adoption, accurate implementation, and sustained use of evidence-based practice related to behaviour and classroom management and school discipline systems (Sugai & Horner, 2011). SWPBIS emphasizes the integration of contextually defined and valued outcomes. That is why contextual fit and culturally responsive adaptation is important when adopting and adapting SWPBIS to a different country and culture than the US (Nelen, 2021).

SWPBIS has a number of defining characteristics (Sugai & Horner, 2011): (1) *behavioural roots* that emphasizes that observable behaviour is an important indicator what individuals have learned and how they operate in an environment, behaviour is learned and rule governed, environmental factors are important in

determining whether a behaviour is likely to occur, and new and alternative social behaviours can be taught (Sugai & Horner, 2002), (2) *prevention* that emphasizes the establishment of a continuum of behavior support interventions and systems. This continuum is often organised within a three-tier prevention logic (Kutash et al., 2006; Walker et al., 1996); (3) instructional focus that emphasizes that directly teaching social behaviours increases social and academic success at school. At the schoolwide level a small number of schoolwide behavioural expectations are taught directly to all students in order to realise a common language and experience for all students, staff members, and family; (4) use of evidence-based behavioural practices that emphasizes that practices are used that have been tested, replicated, and applied through experimental and quasi-experimental designs; (5) a systems perspective in trying to build local capacity and expertise, majority agreements and commitments (PBIS Evaluation Blueprint, 2020; and (6) continual collection of data for active decision making. To reiterate: SWPBIS actively supports teaching and learning environments so that the academic outcomes are maximized and to formalize the school and classroom organisation and operation in order to establish a positive social culture.

2.4. Teaching behavioural expectations as primary-tier SWPBIS interventions

Primary-tier SWPBIS interventions are a set of universal interventions for all students, staff, and community members across all school settings to optimize and foster a comprehensive and positive social culture. Six major intervention features are characteristic for these primary-tier SWPBIS interventions (Colvin et al., 1993):

1) A majority of the staff agrees to embrace a common approach to discipline that is positive, comprehensive, formal, and ongoing and is presented in the form of a schoolwide purpose statement, for example: 'ARETE community is a community of learners. We are hear to learn, grow, and become good citizens.';
2) A set of schoolwide expectations are identified by staff, students and community members that a) are few in number (3 to 5), b) stated positively and succinctly, c) focus on all staff, all students, and all settings, d) emphasize support for academic and behavioural outcomes, and e) are contextually and culturally appropriate;
3) These schoolwide expectations are taught directly and continuously in the same way as academic skills: they are a) defined, b) modelled, c) practiced, d) given corrective and positive feedback, and e) encouraged in the natural and applied setting. The schoolwide expectations are usually depicted in a behavioural expectation matrix;
4) They provide a continuum of procedures for acknowledgement or rewards of students displays of the behavioral expectations;

5) A continuum of consequences for responding to problem behaviours to communicate and teach all which behaviours represent violations of schoolwide behavioural expectations;
6) Information must be accurate, timely, and easily available to guide decision-making.

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3. Content Research and Development of the PBIS-AR application

3.1. Introduction

Schools that work within the SWPBIS framework traditionally start—as part of the primary-tier plan (George et al., 2009)—from the definition of a small set of school values to promote a safe and healthy school environment that allows their students to flourish. Within the PBIS-framework, schools are advised to limit the number of school values to three to five values. However, within these boundaries, PBIS leadership teams are free to choose those school values that they deem most important. Following the establishment of this set of school values, schools continue with the development of behavioural expectations—or behavioural rules—that guide students and staff to behave and act in line with the school values. They are a list of broad, positively stated behaviours, aligned with the school's mission statement. Expectations are specific to a school as they are based on the school's discipline data and the values of the staff and the broader community. These behavioural expectations are positively formulated and/or promote positive action/behaviour (e.g., walk calmly rather than do not run). Posters or visuals of the expectations posted throughout the school premises serve as reminders to students, staff, faculty, parents, and visitors of the desired behaviours and assist in building visibility, increasing buy-in, and maintaining support (George et al., 2009).

Furthermore, for full adherence of students to the school values, behavioural expectations are formulated for all school settings (e.g., corridors, playground, and classroom). Schools' full set of behavioural expectations for all school settings and their link to the school values are summarized in a behavioural expectation matrix which is shared with all students and staff (Sugai & Horner, 2011). This matrix is a useful and efficient format for teaching schoolwide examples of behaviour. The positive expectations are taught using local and real behavioural examples in real contexts or settings of the school. The examples are observable, relevant, and doable. The behavioural expectations are rules that enable and support a common language and consistent communication so that alle community members have clear understandings of what is expected of themselves and others (Sugai & Horner, 2011, p. 313).

Once these behavioural expectations are formulated, rules for how these expectations look in particular settings are developed. How a student is responsible in one setting, may look different from how they are responsible in another setting. Rules are specific and support the leadership team in teaching

the expectations across all settings. By stating the rules positively, students can be taught what they are supposed to do rather than what they are not.
An important aspect of PBIS—in line with social learning and modeling theory—is the active and repeated teaching of these behavioural expectations to students via behavioural lessons. Chapter 5 provides more details about the structure and contents of these behavioural lessons. School staff are responsible for creating a safe learning environment for students in which they can learn expected behaviour (i.e., behavioural expectations). An important tenet within PBIS regards the positive learning of expected behaviour by giving students direct, specific, and positive feedback and/ or positive reinforcement on their behaviour as well as ample opportunities to practice the expected behaviour in all settings where these behaviours are required of them.

Within the ARETE project, a PBIS-AR application is designed to support school staff and students in teaching and learning expected behaviour within the PBIS framework. In order for the PBIS-AR application to reach its full potential in this regard, the contents of the application need to be useful for all schools working with PBIS. However, as is clear from the above, schools individually select their core school values and—following this—decide on behavioural expectations that guide behaviour in line with these school values. Moreover, schools differ within countries and across countries in the school settings available and (deemed) important for teaching students expected behaviour, as well as in how expected behaviour is positively reinforced. Thus, an effective PBIS-AR application follows the most universal: (1) behavioural expectations matrix in terms of school values, behavioural expectations, and school settings; and (2) positive reinforcement systems for rewarding students' compliance to expected behaviour. As such, an important first step in the development of the PBIS-AR application within ARETE's pilot 3 subproject was to establish an ARETE behavioural expectation matrix to guide the creation of AR content within the PBIS-AR application and to integrate the ARETE positive reinforcement system for rewarding students' expected behaviour as shown during the practice of these behaviours. In the following section, the research and development process to this end is described.

3.2. Construction of the ARETE PBIS Behavioural Expectation matrix and PBIS-AR application content

The research and development process towards the universal PBIS-AR application was initially planned to consist of data collection through focus groups with stakeholders (i.e., PBIS-experts and PBIS-teachers). These focus groups were intended to collect the necessary data with regards to developing the ARETE behavioural expectation matrix and reinforcement system. Focus groups were planned within the Netherlands by SVU and in the United Kingdom by SVU in

collaboration with ULE. However, due to the emergence of the COVID-19 pandemic in Europe, only three focus groups (*N* = 12) were conducted in the Netherlands by SVU. Focus groups needed to be put on hold and a contingency plan was put in place. Within the contingency plan, the first step in the research and development process consisted of a literature review for PBIS school values, behavioural expectations, common school settings, and reinforcement systems. While scientific literature on these topics was somewhat scarce, the review provided important input for the next steps in the research and development process.

With regards to school values, a large-scale study among 155 US primary schools in 12 US states by Lynass et al. (2012) suggested that school values are relatively homogenous, at least in the US. By far, most schools were found to define the following three school values: (1) respect (88.7%), (2) responsibility (72.2%), and (3) safety (64.2%). Remarkably, only one other school value—that is, readiness to learn—was defined by more than 10% of the schools recruited in Lynass et al. (i.e., by 26.5% of schools). However, primarily based on Lynass et al., the decision was made to define the school values to be used in the ARETE-project as respect, responsibility, and safety.

With regards to school settings, tentative input for the ARETE behavioural expectation matrix was derived from a recent representative study by Lane et al. (2019) describing the development and psychometric properties of a survey to guide schools in selecting schoolwide behavioural expectations for their matrices. A total of seven common and important school settings was established: (1) classroom, (2) corridors, (3) cafeteria, (4) playground, (5) restroom, (6) bus, and (7) arrival/dismissal. Again, these school settings were based on the situation corresponding to the US schooling system.

Unlike for the school values and school settings, neither Lynass et al. (2012), Lane et al. (2019), or other studies (e.g., Burke et al., 2012, 2014; Carter & Pool, 2012; Simonsen et al., 2012) provided a clear insight into (sub)sets of behavioural expectations most commonly used in schools. However, the literature did converge on the fact that the general elements of the behavioural expectations are similar across schools. Due to a lack of studies examining the most common behavioural expectations used by PBIS schools, an alternative review procedure was necessitated to come to input for the ARETE behavioural expectation matrix in terms of behavioural expectations. Specifically, the behavioural expectation matrices of PBIS schools within the SVU network in the Netherlands were collected. Subsequently, a Google search was executed to reach a total of 20 behavioural expectation matrices from Dutch PBIS schools. To obtain a more universal set of behavioural expectations, the Google search was extended to

include sets of 20 behavioural expectation matrices of PBIS schools in the United Kingdom, United States, Canada, and Australia. Only English language countries were included in this search due to language restrictions. The input of all collected behavioural expectation matrices was combined into one overall behavioural expectation matrix, by maintaining only the most universal behavioural expectations (i.e., those prevalent in multiple matrices in multiple countries). These behavioural expectations were then matched to the above-mentioned school values and school settings to obtain a first longlist of the ARETE behavioural expectations matrix.

Finally, with regards to frequently used positive reinforcement systems, the scope of the literature review was not limited to a PBIS context. Rather, the literature on reinforcement systems used in both real life and in gamification situations was reviewed. Findings converged on a total of six reinforcement systems found to be used frequently in motivating performance of students in schools and/or in games (e.g., Aldemir et al., 2018; Ioannou, 2019; Raczkowski, 2014; Zainuddin et al., 2020). However, the findings did not converge on a universally most effective reinforcement system. Therefore, a tentative list of six reinforcement systems was selected: (1) badges, (2) points, (3) leader boards, (4) progress bars, (5) virtual goods, and (6) tokens.

3.3. Validation of the ARETE PBIS Behavioural Expectation Matrix and PBIS-AR application content

The second step planned within the research and development process consisted of both validating and slimming down the outcomes of the literature review regarding the longlist of the ARETE Behavioural Expectation Matrix and reinforcement system with stakeholders (i.e., PBIS-teachers and students) through focus groups in the Netherlands held by SVU and in the United Kingdom by SVU in collaboration with ULE. The main goal of this process was to arrive at a shortlist of the ARETE Behavioural Expectation Matrix and reinforcement system consisting of twelve behavioural expectations and two reinforcement mechanisms to be used in the PBIS-AR application. The twelve behavioural expectations would subsequently be used to create AR content to guide student learning of expected behaviour. Due to resurgence of the COVID-19 pandemic throughout Europe, only two focus groups with stakeholders (N = 8) could be conducted in the Netherlands by SVU. While these focus groups partially validated and slimmed down the data with regards to school values and settings, no reliable conclusions could be drawn on the limited input from stakeholders with regards to behavioural expectations and reinforcement systems.

A contingency plan was again put in place to continue with the research and development process for the PBIS-AR application. Specifically, an online questionnaire—the PBIS in Europe or PBIS-E questionnaire—was developed by SVU that contained items regarding school values, behavioural expectations, and reinforcement of expected behaviour.[2] Items served to both establish the intended shortlist ARETE behavioural expectations matrix and reinforcement system, as well as to question stakeholders (i.e., PBIS teachers and 4th through 6th grade students) about missing content with regards to school values, behavioural expectations, and reinforcement systems. The full questionnaires for teachers and students can be found in Annexes A and B respectively. All information letters and consent forms used can be found in Annex C. Ethical approval for the PBIS-E study was obtained via the Ethical Review Board (ERB) of SVU.

SVU as the lead of the PBIS-Europe network, approached PBIS-colleagues, in 10 European countries (i.e., the Netherlands, Germany, England, Scotland, Guernsey, Finland, Lithuania, Spain, Portugal, Italy) to enable a broad and thorough validation process. Despite intensive school recruitment efforts, data collection was only successful in four countries (i.e., the Netherlands, Italy, Lithuania, and Portugal). The other countries were forced to opt out of the assessment and validation study during the school year of 2020-2021 as schools continued to suffer the consequences of mandatory school closure due to the COVID-19 pandemic (e.g., teaching was prioritized over participating in research, overflowing workload for teachers).

Data were collected during the first half of 2021 in the Netherlands, Italy, Lithuania, and Portugal. During this time, it was possible to fully collect data in Italy and Lithuania. In the Netherlands and Portugal data collection was still ongoing in July (i.e., only partial data is included in the current report). Furthermore, arrangements have been made with some of the other European countries approached for participation in the study (e.g., Spain, Germany, England) to collect data after the summer break during the school year of 2021-2022. Preliminary outcomes are reported below.

Table 3.1 provides the sample distribution of PBIS teachers and 4th through 6th grade students who provided active informed consent for participation in the PBIS-E study (i.e., student consent was obtained through parents/ guardians) over participating countries. As sample sizes were quite small at the country level for the Netherlands and Portugal, data were collapsed over countries. Findings are reported for the collapsed teacher and student samples and for the total sample

[2] The PBIS-E questionnaire also contained a section with items gauging teachers' and students' use of AR for educational purposes. These findings are reported in Chapter 5.

(i.e., teacher and student data combined), unless otherwise indicated. The teacher sample consisted predominantly of females (i.e., 90.4%), contained a minority of participants with a non-teaching role at their school (i.e., 23%; e.g., school administrator, remedial teacher, or school psychologist), and had a mean age of 47.7 years (*SD* = 10.7 years). The student sample was quite balanced in terms of gender (i.e., 51.2% girls) and had a mean age of 10.6 years (*SD* = 0.9 years).

Table 3.1.
Sample distribution over participating countries of consenting participants and final full dataset.

	Approached with consent		Full data available	
	Teachers	Students	Teachers	Students
	N	*N*	*N*	*N*
Total sample	237	245	135	209
Italy	91	94	71	81
Lithuania	98	145	47	123
the Netherlands	25	5	14	4
Portugal	23	4	3	1

First, in both the teacher and student PBIS-E questionnaires, school values were gauged through four items. Three items regarded the importance of the school values respect, responsibility, and safety in participants' school. These items were rated on a 5-point Likert scale ranging from 1 (very unimportant) through 5 (very important). A fourth open-ended item questioned participants about the school values at participants' school. While not all schools had defined the school values as respect, responsibility, and safety, all three school values were rated as very important and similar by teachers and students (see Table 3.2 for *M*s, *SD*s, and rankings). School values defined by schools often contained derivatives of these three school values, such as trust and solidarity.

Table 3.2.
Descriptive statistics and rankings for school values gauged in the PBIS-E study.

	Overall (*N* = 344)			Teachers (*n* = 135)			Students (*n* = 209)		
	M	*SD*	Rank	*M*	*SD*	Rank	*M*	*SD*	Rank
Respect	4.53	1.02	2	4.53	1.11	2	4.53	0.96	2
Responsibility	4.47	0.99	3	4.46	1.04	3	4.48	0.96	3
Safety	4.58	0.97	1	4.56	0.98	1	4.60	0.96	1

Second, in both the teacher and student PBIS-E questionnaires, behavioural expectations were gauged through 17 items. Fifteen items regarded the importance of the fifteen behavioural expectations: (1) schoolwide, (2) in the classroom, and (3) in other school settings. These items were rated on a 5-point

Likert scale ranging from 1 (very unimportant) through 5 (very important) and subsequently collapsed at the level of behavioural expectation (i.e., averages were calculated over the three items per behavioural expectation). One open-ended item questioned participants about other behavioural expectations they deemed important at their school. A final item questioned teachers only about the specific situation in which it was most important for students to learn the behavioural expectation "store your belongings" (options: storing jacket and backpack, school equipment, both, or other). This final item was added as stakeholders in the focus groups (see above) were not unanimous regarding the best learning example for this behavioural expectation. Results are reported in Table 3.3.

Table 3.3.
Descriptive statistics and rankings for behavioural expectations gauged in the PBIS-E study.

	Overall			Teachers			Students		
	M	*SD*	Rank	*M*	*SD*	Rank	*M*	*SD*	Rank
Walk with a goal	4.12	1.03	14	4.10	0.99	14	4.14	1.06	12
Keep doors open for others	3.97	1.09	15	3.87	1.09	15	4.03	1.08	15
Greet others	4.43	0.89	9	4.40	0.97	9	4.45	0.83	8
Throw trash in the bin	4.68	0.79	1	4.64	0.88	1	4.71	0.73	1
Wash (with soap) and dry your hands	4.50	0.90	5	4.51	0.96	3	4.50	0.87	6
Sit while you eat/ drink	4.47	0.88	6	4.53	0.91	2	4.42	0.86	10
Keep your hands/ feet to yourself	4.37	1.04	11	4.42	1.05	7	4.34	1.04	11
Use stop/ walk/ talk to solve problems	4.16	1.20	12	4.33	1.04	11	4.05	1.28	14
Keep your working space organized	4.51	0.88	4	4.46	0.95	5	4.54	0.83	4
Store your belongings	4.46	0.92	8	4.32	1.00	12	4.54	0.85	4
Let others be (let others play)	4.16	1.13	12	4.32	1.05	12	4.06	1.17	13
Help others with questions	4.47	0.89	6	4.46	0.85	5	4.47	0.93	7
Stand up for others	4.53	0.93	3	4.49	0.92	4	4.55	0.93	3
Work independently at your desk	4.40	0.83	10	4.35	0.87	10	4.43	0.81	9
Flush the toilet after your visit	4.55	0.93	2	4.42	1.04	7	4.64	0.84	2

Note. Behavioural expectations sharing mean scores in (sub)samples were given the same rank.

All behavioural expectations were rated as important to very important (see Table 3.3 for *M*s, *SD*s, and rankings) and were ranked —with some exceptions—similarly by teachers and students. Other important behavioural expectations were mentioned by participants, although these often were different formulations for the same core behavioural expectation (e.g., keep your workspace tidy vs. keep your workspace organized, or support others vs. help other with questions/ stand up for others) or a repetition of one of the included 15 behavioural expectations.

Other behavioural expectations mentioned regarded adherence to anti-COVID-19 safety measures and expected behaviour in the online teaching environment. Finally, with regards to the behavioural expectation "store your belongings", both storing personal belongings and school equipment were found to be equally important (i.e., 86.7% of the teacher sample), with slightly more teachers emphasizing storing school equipment (i.e., 9.6%) than personal belongings (3.7%) and no other important situations mentioned.

Last, in both the teacher and student PBIS-E questionnaires, reinforcement systems were gauged through 26 items in each questionnaire. In the teacher questionnaire, four sets of six items regarded teachers' use and perceived effectiveness of the six types of reinforcement in both physical teaching and online teaching environments. These items were rated on a 5-point Likert scale ranging from 1 (low end marker) through 5 (high end marker) and were collapsed over physical and online teaching environments due to similarity in scores (i.e., averages were calculated for use and effectiveness of each reinforcement system). Two further open-ended items were used to question teachers about their reinforcement of expected behaviour in physical and online teaching environments. In the student questionnaire, four sets of six items regarded students' motivation and desire to receive the six types of reinforcement in both school and game situations. These items were rated on a 5-point Likert scale ranging from 1 (low end marker) through 5 (high end marker) and were collapsed over both school and game situations and over motivation and desire due to similarity in scores (i.e., averages were calculated overall for each reinforcement system). Two further open-ended items were used to question students about typical reinforcement of expected behaviour by teachers and about other types of reinforcement that may motivate good performance on their behalf.

Table 3.4.
Descriptive statistics and rankings for reinforcement systems gauged in the PBIS-E study.

	Teachers (*n* = 135)						Students (*n* = 209)		
	Use			Perceived effectiveness					
	M	*SD*	Rank	*M*	*SD*	Rank	*M*	*SD*	Rank
Badges	3.16	1.29	1	3.44	1.21	1	4.03	1.14	2
Points	3.12	1.39	2	3.30	1.33	2	3.99	1.14	3
Leaderboards	2.60	1.48	4	2.78	1.48	5	4.05	1.12	1
Progress bars	2.83	1.43	3	3.00	1.38	3	3.98	1.17	4
Virtual goods	2.45	1.39	6	2.72	1.40	6	3.82	1.33	5
Tokens	2.57	1.40	5	2.80	1.36	4	3.79	1.31	6

Reinforcement systems were rated considerably less favorable by teachers than by students (see Table 3.4 for *M*s, *SD*s, and rankings). Reinforcement systems

were also ranked slightly differently by teachers and students. While both badges and points were ranked top 3 by teachers and students, students ranked leaderboards as the strongest motivator for performance while teachers ranked this reinforcement system as bottom 3. Interestingly, teachers also did not perceive leaderboards effective in motivating student performance. Open-ended answers by teachers indicated primarily reinforcement of expected behaviour through positive reinforcement (i.e., general practice in PBIS), while open-ended answers by students could be summarized in the reinforcement systems that were gauged.

3.4. Conclusions of the content research and development process for the ARETE PBIS-AR application

The outcomes of the PBIS-E study further validated the findings obtained through the literature review and resulted in the slimmed down shortlist of the ARETE Behavioural Expectation Matrix and reinforcement system. As such, the outcomes allowed us to converge on reliable input for the universal ARETE PBIS-AR application. The findings are summarized below.

With regards to school values, the findings of the PBIS-E study aligned with the findings of the literature review. The school values defined for the ARETE PBIS-AR application therefore are (ranked in order of importance): (1) Safety, (2) Respect, and (3) Responsibility. The findings further suggest that when schools use different school values, these values generally tend to fall under the umbrella of these three school values.

With regards to school settings, the conclusions follow the literature review and the focus groups held. After taking into account differences between countries the settings bus and arrival/ dismissal were merged into one setting. In the Netherlands for example students often come to school on bike and are brought to school by car by their parents/ guardians in other countries. The final set of school settings included in the ARETE-PBIS AR application are therefore: (1) arrival/ dismissal, (2) corridors, (3) breaks/ lunch, (4) playground, (5) restroom, and (6) classroom. Findings of the PBIS-E study suggest that according to teachers (and students) most behavioural expectations need to be adhered to in all/ most of these settings.

With regards to behavioural expectations, the findings of the PBIS-E questionnaire resulted in a slimmed down and ranked list of behavioural expectations for which AR content can be developed in the ARETE PBIS-AR application. While teachers and students slightly differed in the importance attributed to some of the behavioural expectations gauged in the PBIS-E study (see Table 3.3), reports were

generally in consensus. Moreover, with the exception of the bottom two behavioural expectations, differences between importance attributed to the behavioural expectations were small and negligible. The final ARETE Behavioural Expectation matrix shortlist therefore includes all 15 behavioural expectations and can be found in Table 3.5.

Table 3.5.
Final ranked ARETE Behavioural Expectations matrix shortlist

1	Throw trash in the bin
2	Flush the toilet after your visit
3	Stand up for others
4	Keep your working space organized
5	Wash (with soap) and dry your hands
6	Sit while you eat/ drink
	Help others with questions
8	Store your belongings
9	Greet others
10	Work independently at your desk
11	Keep your hands/ feet to yourself
12	Use stop/ walk/ talk to solve problems
	Let others be (let others play)
14	Walk with a goal
15	Keep doors open for others

Note. Some of the behavioural expectations shared the same ranking in the final shortlist.

Finally, with regards to the reinforcement system, the findings of the PBIS-E study, teachers and students did not completely agree on the most effective and motivating reinforcement systems to include in the ARETE PBIS-AR application. The decision was made to base the final set of reinforcement systems primarily on the student data, as the end goal of reinforcement is to motivate students to perform well. As such, the reinforcement systems to include in the PBIS-AR application are (ranked in order of importance): (1) leaderboards, (2) badges, and (3) points. The final three reinforcement systems are also relatively easily combined (i.e., points and leaderboards).

With regards to these reinforcement systems, the idea is to support the reinforcement of appropriate behaviour in the PBIS-AR application through videos that students make of each other during the practice phase present in the behavioural lessons (see Chapter 5 for the lay-out of the scripted behavioural lessons). To this end, badges and leaderboards based on experience points scored will be developed that will provide students visual reinforcement of how well they

are performing in learning expected behaviours. However, the reinforcement system and further solutions to incorporate these into the PBIS-AR applications are still to be evaluated by the consortium partners and the choice and implementation will ultimately be described in the update of this deliverable (i.e., deliverable D5.3).

4. Augmented Reality supporting behavioural teaching and learning: A summary of the state of the art.

4.1. Introduction

The ARETE project within WP5 aims at investigating, developing and evaluating the effectiveness of introducing the AR technology for promoting expected behaviour at school within the framework provided by SWPBIS. We argue that AR can represent an effective tool to support students' learning of shared values and behavioural expectations, as pillars of the promotion of positive behaviours at school. In other terms, AR can be a promising technology to support behavioural teaching and learning processes integrating it in behavioural activities aimed at teaching positive behavioural routines and alternative responses, reducing the incidence of problem behaviour and supporting the behavioural change.

In this regard, literature has shown that individuals who use different types of AR applications are more open to expected behavioural changes (Connolly et al., 2012). Moreover, according to recent reviews (Garzón et al., 2019; Ozdemir et al., 2018), the prevalent use of AR in education concerns the broad field of natural sciences, while only a paucity of studies explored the support provided by AR in social sciences and these focused on the psychology, and health and welfare fields of intervention. To the best of our knowledge, no reviews have specifically addressed the use of AR within interventions designed for behavioural teaching or training.

We conducted a scoping literature review to fill this research gap by investigating the use of AR technology within interventions designed for behavioural teaching and learning, with a specific focus on educational settings. The present review also undertook an exploration of the context of AR technology and its ability to influence social behaviour. Papers were selected and reviewed with the aim of identifying the state of the art of existing AR applications and solutions developed for behavioural teaching and learning, especially with regard to both the:

1. Pedagogical framework informing the interventions; and
2. Implemented AR technology.

For the purpose of this report, we include here only a summary of the methodology we followed to conduct the review and two additional sections. One section is devoted to the main advancements introduced by the Pilot 3 AR solution to the state of the art of AR use in behavioural teaching and learning as highlighted by the current scoping review; the other section is intended to provide a brief description of results from the section of the PBIS-E questionnaire related to AR use for educational purposes.

For further details, a full version of the scoping literature review can be found at the Annex E.

4.2. Methodology

The review was primarily interested in the exploration of the use of AR solutions in the context of interventions designed to promote the acquisition of behavioural skills, regardless of the specific target population and intervention setting. An additional review's goal was to look at some of the key aspects of using AR technology and its effect on social behaviour and social interactions. Accordingly, the present work sought to answer the following research questions:

- How is AR used in the context of interventions designed for teaching or training a behaviour?
- What is the impact of using AR on social behaviour?

A total of 1587 and 455 papers were identified as a result of the search strategies followed to answer the first and the second research questions respectively.

After a careful screening process, a total of 71 papers were reviewed and charted for the purposes of the current work.

4.3. Pilot 3 Advancements to the State of the Art

We describe here a shortlist of the advancements to the state of the art of AR use in behavioural teaching and learning that could guide the implementation of AR solution for Pilot 3. The presented advancements follow recommendations and address gaps in the literature as highlighted by the results of the scoping literature review. For further details about the relevant findings of the scoping review, please refer to the full version at the annex E.

- Studies suggest promising findings about the effectiveness of augmented reality-based treatments for the promotion and support of social skills in children and adolescents with special needs.
- No research has yet investigated the impact of AR solutions for the promotion of students' outcomes at a schoolwide level and mainly from a prevention perspective. In this regard, the Pilot 3 AR solution introduces a novelty as far as it is specifically designed for SWPBIS, a schoolwide and preventive approach promoting students' positive behaviour and scholastic outcomes and grounded on a strong and well-validated theoretical framework.

- Following previous research on positive behaviour supports for students with special needs (e.g. Pas et al., 2016), the ARETE Pilot 3 extends to students the use of AR for training purposes and rigorously validates the use of AR technology in the context of mainstream education.
- Following recommendations from existing research (Holley & Howlett, 2016), the Pilot 3 actively involves students' perspective in the selection of relevant behavioural issues and the design of educational material.
- Pilot 3 AR solution advances previous work (Tentori et al., 2015) as far as provides an AR solution that can be used for both teaching and practicing expected behaviour.
- Following previous research (Bridges et al., 2020; Chen et al., 2016), the AR-PBIS solution relies on a combination of AR and video-modelling strategy to teach behavioural skills. The assumption is that AR can attract students' attention and highlight relevant content during the training of the expected behaviours (Chen et al., 2016; Hsu & Lee, 2020)
- Moreover, the AR-PBIS solution represents an advancements since it overcomes the marker-based solutions with a marker-less solution that allows the positioning of AR contents on the basis of environment recognition.
- Differently from existing AR solutions e.g. (Chen et al., 2016; Hsu & Lee, 2020), the AR software solution for PBIS is designed to allow teachers to produce their own behavioural educational resources in AR in a dynamic way making them usable in their own school context of interest.
- Based on existing research (e.g. Hsu & Lee, 2020; Shirai et al., 2020), the use of AR 3D characters and animations, virtual environments, and simulations can be useful for modeling positive behavioural routines.

4.4. PBIS-E study findings regarding use of AR for educational purposes

The PBIS-E questionnaires for teachers and students reported in Chapter 3 also contained a brief section with items regarding the use of AR application in school for educational purposes. The multiple choice and open-ended items used to gauge teachers' and students' attitudes towards using AR for educational purposes can be found in Annexes A (i.e., Part 5) and B (Part 4) respectively. The findings are summarized below, and a full reporting of the outcomes will be included in Deliverable 4.5 (due in project month 25). Sample descriptive statistics are reported in Chapter 3.

First, with regards to the estimated general availability of devices for using AR in the PBIS-schools participating in the study, tablets were most commonly available in schools and most notably so in the Netherlands (see Figure 4.1). Smartphones were commonly available (almost) exclusively in Italy. Computers (i.e., desktops

and/ or laptops) with Webcam were found to be quite commonly available in the PBIS-schools of all countries that participated in the study.

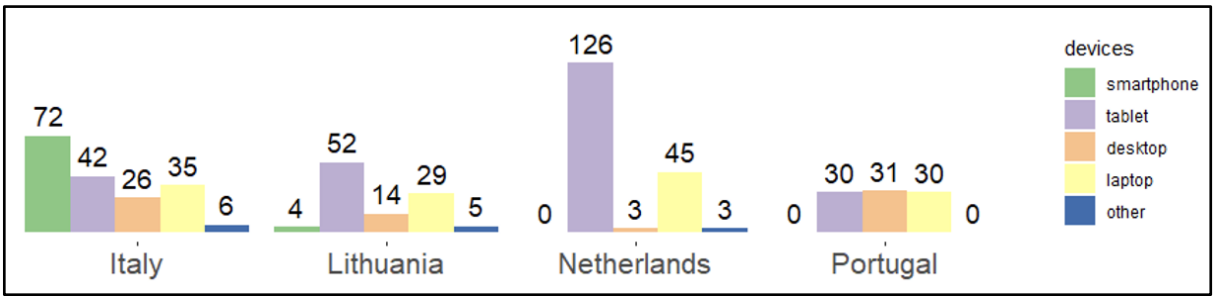

Figure 4.1. *Distribution of average number of available devices for AR applications per country, separated by type of device.*

Only a few teachers (i.e., 24% of the total sample) participating in the PBIS-E study had experience with using AR in their teaching, mostly via smartphone or tablet applications (laptops or desktops with Webcams were mentioned slightly less frequently). Almost all of the teachers with AR experience (i.e., 90% of the subsample) used AR applications in their teaching frequently (i.e., daily to monthly). The attitude towards using AR for educational purposes of these teachers were also mostly favorable (i.e., only 13% of the subsample reported to dislike using AR). Primary reasons for a positive attitude towards using AR for educational purposes were the increased student/ teacher motivation and support for learning/ teaching, as well as the widening of the available teaching/ learning material. Primary reasons for a negative attitude towards using AR for educational purposes came from technical aspects (e.g., lack of available devices/ tools and unstable internet connection), although some teachers also indicated high time consumption or dependence/ addiction as cause for their negative attitude.

All teachers—regardless of their experience with using AR for educational purposes—were asked about their confidence in using AR in their teaching. Only 10% of the teachers with AR experience felt unconfident in using AR in their teaching vs. almost half of the teachers without AR experience (i.e., 42%). Primary reasons for being confident in using AR in teaching were enthusiasm and benefits of AR technology for education, as well as prior experience with using AR and modern technologies more in general. Primary reasons for being unconfident in using AR in teaching were lack of knowledge and experience in using AR. Finally, teachers indicated that their confidence in using AR for educational purposes would increase with additional training and practice and/or more available materials and applications for using AR in teaching.

When asked about the benefits of using AR in their PBIS-teaching of behavioural expectations specifically, approximately two-thirds (i.e., 64%) of all teachers—regardless of AR experience—indicated that AR would be beneficial to their PBIS-

teaching of behavioural expectations. Only a few teachers (i.e., 12%) indicated that AR would not be beneficial to their PBIS-teaching of behavioural expectations. Prior experience with AR did not influence teachers' opinion of the benefit of using AR in their PBIS-teaching of behavioural expectations. Primary reasons for positive expectations of using AR in PBIS-teaching of behavioural expectations were increased motivation/ engagement in students, student/ teacher support in learning/ teaching, and the expectation of improvement of student behaviour. Primary reasons for negative expectations of using AR in PBIS-teaching of behavioural expectations were the legitimate concerns that AR would be used improperly by students and the availability of devices to use the AR applications with.

Only a few students (i.e., 15%) participating in the PBIS-E study had experience with using AR for learning in school. The attitude towards using AR for educational purposes of these students was also mostly favorable (i.e., only 10% of the subsample reported to dislike using AR). Primary reasons for a positive attitude towards using AR for learning in school were related to the content learned and the process of learning—interactively and/ or virtually. Few reasons for a negative attitude towards using AR for learning were provided by students (i.e., approximately 84% of the subsample reported no negative aspects), but technical problems (e.g., long loading time of the content) were mentioned.

When asked whether students would like to learn appropriate behaviour (i.e., behavioural expectations in PBIS-education) through AR specifically, roughly two-thirds of students responded favourable regardless of previous experience with using AR for educational purposes (i.e., 64% of the total sample and 61% of the subsample with AR experience). Only a few students (i.e., roughly 17%) indicated that they would not like to learn about appropriate behaviour through AR applications. When asked about what type of appropriate behaviour students would like to learn most through AR applications, primary appropriate behaviours were related to social behaviour and peer relationships, the common school values (i.e., respect, responsibility, and safety), and (social) cognitive skills (e.g., executive functioning skills like self-regulation).

4.5. Conclusions for using AR for the ARETE PBIS-AR application

With regards to attitude towards AR, both teachers and students were mostly optimistic about teaching and learning appropriate behaviour via AR, this is reflected in the many positive responses regarding using AR for educational purposes. The teachers expected that AR will help motivate the students, support teaching, and improve students' behaviour. The students hoped that using AR within their PBIS-education will support them in learning appropriate behaviour in

social settings and with regards to peer relations specifically, besides supporting their existing learning of appropriate behaviour in line with the school values (respect, responsibility, and safety). However, less than a quarter of teachers and students had experience with using AR in the school setting. This led to a lack of confidence among teachers and high numbers of unsure responses in all questions. To improve the confidence, multiple teachers suggested additional training and expansion of available materials. Several teachers were also concerned about the availability of AR-compatible devices, potential technological issues (e.g., internet connection) and that students will misuse the AR devices.

5. Design of Behavioural Lessons for PBIS

5.1. Introduction

The methodology used to design behavioural lessons for PBIS that are going to be used as the treatment in the intervention study from 2021-2023 (non-AR vs. AR) is Lesson Study (LS). Within each behavioural lesson a behavioural expectation is targeted stemming from the slimmed down and ranked list of behavioural expectations for which AR content will be developed in the ARETE PBIS-AR application. The final ARETE Behavioural Expectation matrix shortlist includes all 15 behavioural expectations and can be found in Table 3.5. When designing the behavioural lessons reinforcement systems like (1) leaderboards, (2) badges, and (3) points will also be embedded.

LS is a rapidly growing and increasingly popular teacher professional development approach, that originated in Japan, and is valued for its cyclical, classroom-based and collaborative nature (Fernandez & Yoshida, 2004). LS has a long tradition in Japan of more than a hundred years of dedicated teachers to research teaching materials, develop lesson plans and practise teaching lessons. In the following the LS-VU-model (Goei, 2013; 2014) is described, followed by the pedagogy of PBIS-behavioural lessons, and lastly by a draft of the developed template of a PBIS behavioural lesson with a few examples of PBIS-behavioural lessons attached to it.

5.2. Lesson Study as Methodology to Design Lessons

LS is characterized by collaborative and inquiry learning by teachers, a strong alignment with teachers' own teaching practice, a focus on subject matter content, and a focus on student learning. These features are strongly associated with effective professional development (Dudley et al., 2019; van Driel et al., 2012).

LS involves small groups of teachers participating in inquiry cycles of collaborative planning, teaching and 'live' observing, evaluating, and refining so-called 'research lessons' (Lewis et al., 2006). A LS cycle is organised around a classroom-based problem or issue that members of a LS team face while teaching a particular group of students. Addressing this issue, the team explicitly focuses on student learning, often using 'case pupils' (Dudley, 2013) who represent a group of students in terms of their learning or behaviour. In the research lesson, team members collect data on student learning based on observation criteria that the team defined (Lewis, 2002). Generally after two or three LS cycles per year, the LS team reflects on their learning and often disseminates what they learned via professional publications or public research lessons (Dudley, 2013). LS teams are often

facilitated by a LS facilitator who leads the team through the process and provides new theory and insights (Schipper et al., 2017).

The SVU-team has extensive experience with the deployment of LS with teacher teams in schools, both in the Netherlands and internationally (Bosma & Goei, 2021; Goei et al., 2021a,b; Goei et al., 2021; Kaskens & Goei, 2021; Norwich et al., 2020; Schipper et al., 2018; Van Halem et al., 2016). Just recently they explored how to use LS to promote social inclusion within a prevocational school setting (Pronk et al., 2020).

The LS-model used for the design of a series of behavioural lessons to be used as the treatment during the intervention period of pilot 3 for both the traditional and the AR-enriched PBIS conditions (See for an extensive description 6.1.), was based on the LS-VU model developed by Goei (2013; 2014) in which she uses a multi-tiered logic (Kratochwill et al., 2007) and includes 'case pupils' (Dudley, 2013). Goei and her team at SVU began implementing this modified approach to LS within in-service teacher training in 2016.

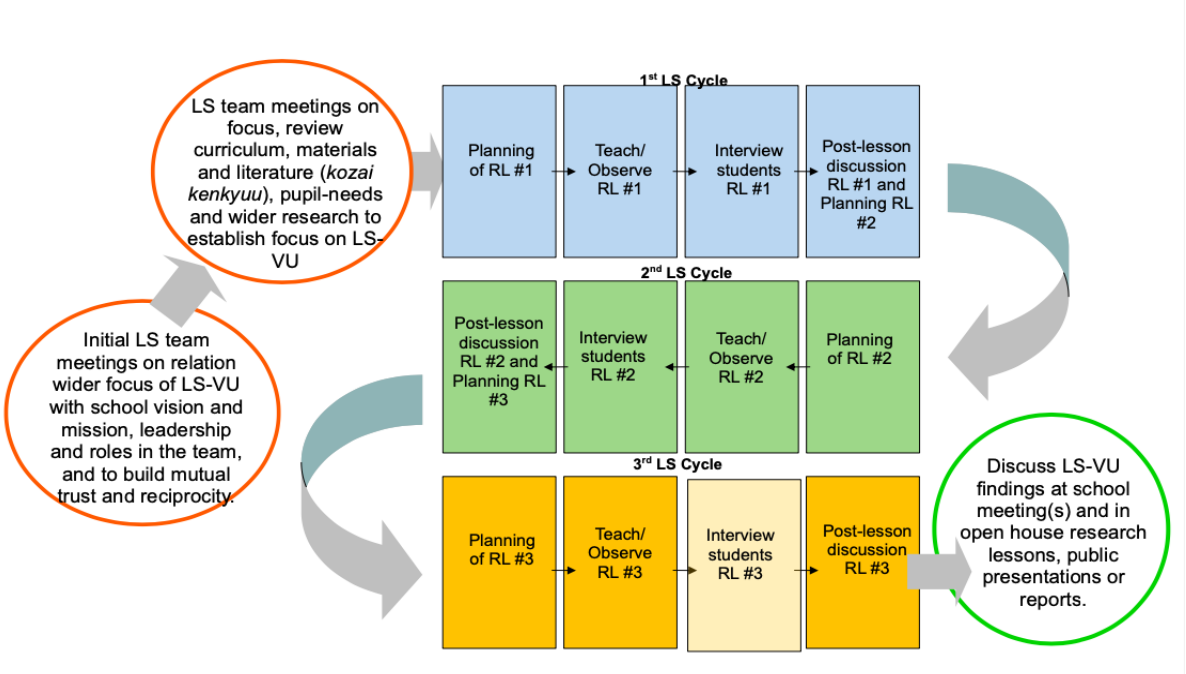

Figure 5.1. *LS-VU 2.0 infused with kyouzai kenkyuu (Goei, 2021).*

Based on extensive experiences Goei has refined the initial LS-VU model with two research lessons within a cycle to a model with three research lessons and a more extensive period of so-called *kyouzai kenkyuu,* or 'the study of materials for teaching', a critical yet often overlooked phase in LS adopted in countries beyond Japan (Choy & Lee, 2021). This curriculum study phase allows participating teachers to carefully examine curriculum documents, textbooks, already

developed teaching and learning materials, and other relevant research to inform the development of a unit or lesson series within which is embedded the lesson. The LS-VU 2.0 model is depicted in Figure 5.1.

5.3. Behavioural Lessons Within PBIS

An important aspect of PBIS—in line with social learning and modeling theory—is the active and repeated teaching of these behavioural expectations to students via behavioural lessons. Teaching and acknowledging positive behavioural expectations are paramount (Sugai & Horner, 2011). They are taught directly and continuously in the same manner as academic skills. The behavioural expectations are defined, modeled, practiced, given corrective and positive feedback, and encouraged in the natural and applied setting. Important also is that the behavioural expectations are taught using local and real behavioural examples in real contexts or settings within the school, that are observable, relevant, and doable.

Once behavioural expectations and rules are developed, the leadership team creates rewards or incentives not only for students but also for adults to encourage the expected student and adult behaviour in the school. Developing a reward system is a critical component in that it increases the likelihood that desired behaviours will be repeated. It is necessary that the types of rewards are varied to maintain interest. They can be social, activity-based, sensory, escape-based or they can be tangible items, such as edibles, materials, and tokens. The following guidelines can be used to develop a reward system (Florida PBIS project, 2006):

1. Keep it simple,
2. Target all students,
3. Reward frequently in the beginning,
4. Reward student contingent on desired behaviour,
5. Use age-appropriate rewards,
6. Refrain from taking or threatening from a student once rewards have been earned,
7. Provide reward throughout the day,
8. Clearly define the criteria for earning the reward,
9. Ensure portability for use in multiple settings,
10. Provide flexibility to meet the needs of diverse students,
11. Vary rewards to maintain students interest.

Teaching positive behavioural expectations are considered universal primary-tier interventions and are of critical importance in that it establishes the safe and efficient environment in which effective teaching and learning can take place. The

primary tier can also be considered a 'core curriculum' for teaching behaviour (George et al., 2011). A description of how the leadership team of a school creates and implements a cohesive and efficient system of behavioural support goes beyond the scope of this report. For the purpose of this report we will focus on the lesson plans for teaching the expected behaviours.

5.4. Process of Developing the Behavioural Lessons

Behavioural skills need to be directly taught, routines that are clearly defined and behaviour expectations relevant to a specific setting need to be encouraged. Appropriate behaviours are necessary for academic success, procedures and routines create structure, and repetition is a factor in learning new skills. The same teaching principles and strategies to provide instruction for academics are used to teach behavioural expectations (Sugai & Horner, 2011).

The leadership team in a school will develop a variety of activities to teach the appropriate behaviour, such as kickoff events, ongoing direct instruction, embedding into other curriculum, and booster training or retraining. The more there is opportunity to be exposed to the appropriate behaviour via for instance modeling of the desired behaviour by adults or staff in school, and students are provided with written and visual cues in the settings where the behaviour is expected, efforts are acknowledged, plans to reteach and restructure teaching are developed, and students are allowed to participate in the development process, and 'teachable moments' are used in core subject areas and during nonacademic times, the more successfully the new behavioural skills are acquired and maintained (George et al., 2011).

The majority of problem behaviours are caused by a lack of adequate routines. Thoughtfully, carefully constructed routines establish both student and teacher expectations and allow activities to take place more efficiently, thereby decreasing the likelihood of inappropriate behaviours. Some routines will be the same and can be taught similarly across multiple settings, whereas some behaviour and routines are setting specific. The posting of visual and graphic displays of routines by posters and stickers supports consistent implementation and compliance with routines (Newcomer et al., 2011).

The SVU-team collaborated closely with three teacher teams of Dutch primary schools and three Dutch PBIS-experts to develop and validate a series of behavioural lessons for the ARETE PBIS-AR application based on the shortlist of behavioural expectations resulting from the PBIS-E study described in Chapter 3. Each LS-team consisted of two teachers and a PBIS expert and was led by one of the members of the SVU-team. The procedures of the LS-VU 2.0 (Goei, 2021) as

described above were followed. First, in June 2020, there were two introductory meetings with all participants, where the shortlist of behavioural expectations were discussed and a template for a scripted behavioural lesson was set. Second, in the remainder of June and in July before the summer break kicked in, each teacher team came together online to design two or three behavioural lessons for behavioural expectations of their choice. Third, in the last meeting before the summer each teacher team discussed and gave feedback on each other's scripted behavioural lessons. Also, a tentative order of the behavioural expectations within a series of lessons was discussed. The advice was to start with the behavioural expectations with which students can easily have a good experience and book success, such as 'Greet others' or 'Keep hands/feet to yourself'. In total, a draft of seven behavioural lessons was developed. Fourth, not all behavioural expectations could be covered before the summer break. The teams needed more time to fully design the modelling of the examples and non-examples typical for PBIS direct instruction of teaching social behavioural skills. The series of scripted behavioural lessons—including the sequence of examples and non-examples—will be updated after summer break during September and October, when also the direct teaching of the behavioural lessons is planned in the schools of the teacher teams. The designs of the full package of ARETE PBIS-AR behavioural lessons will be included in D5.3 (i.e., the update of D5.1).

The process of lesson development is based on the following preferred practices (Newcomer et al., 2011, p. 500-501):

1. provide multiple examples and nonexamples and variations of the behavioural skill relevant to the specific setting;
2. sequence positive and negative examples that are minimally different to maximize discriminations about when and where the skill should be used. Teach the skills with and across a range of contexts where they will be applied.
3. teach directly and actively by modeling and demonstrating the skill, variations of the skill, and the conditions under which the skill should be used (a critical rule). Teachers point out the critical features of the modeling or demonstration as they are presented ('See how he is moving quietly along the right side of the hallway').
4. provide opportunities for students to practice and to rehearse the skill with assistance (verbal prompts) and feedback and then without assistance to test their knowledge and accurate use of the skill.
5. Review skills and routines regularly, for instance by demonstrating the skill or describing the context in which a skill is used.
6. Acknowledge and reinforce appropriate displays of the skill frequently.

5.5. Template of Behavioural Lesson for Teaching Behavioural Expectations

The Lesson Study teams, consisting of PBS teachers and experts, jointly created a template for a behaviour lesson that was subsequently used in the lesson design process.

The template focuses on the integration of four key elements:

1. *Outcomes*: A clearly articulated description of the behaviours required to promote safe and effective school environments that are endorsed by staff and students.
2. *Practices*: A set of evidence-based interventions and strategies used to teach, supervise and monitor both non-classroom and classroom settings.
3. *Data*: Information used to identify the current status and need for change, and to monitor effects of interventions and guide decisions.
4. *Systems*: The support needed to implement and sustain systems of PBIS.

The template for a scripted behavioural PBIS lesson to teach appropriate behaviour is described below in Figure 5.2. This template will also form the basis for the technological affordances of the implementation of a PBIS lesson through the AR application. The process is still ongoing and the results and conclusions will be reported in the updated deliverable D5.3.

(Schoolwide) Behavioural expectation (expected behaviour): This entails the following specific behaviour: Setting:
Lesson objective: Subgoals:
(Schoolwide) Behavioural expectation (expected behaviour): This entails the following specific behaviour: Setting:
Lesson objective: Subgoals:

PBIS value:
Starter/prompt/remind
Short and tangible, attract attention by showing/telling (approx.1 minute)
Teach: instruction and explain **Specify student behaviours**
Includes stating lesson objectives and making it visible. Underlying principle: shared responsibility for a safe and effective school environment endorsed by all (staff, students, and parents)
Modeling
Teacher models expected behaviour: 3 x example behaviour, 1x non-example behaviour
Practice
A set of evidence-based interventions and strategies used to teach, supervise and monitor both non-classroom and classroom settings.
Reflection/review
Attainment of the lesson objective is evaluated with students: • *give the students feedback (praise appropriate behaviour and identify problems)* • *solicit student feedback: "How did we do on xxxxxx today?* • *deliver consequences as necessary*
Acquirement and retention
Post-lesson: call attention to or practice behavioural expectation daily during one week

Evaluation
Post-lesson: evaluate learned behaviour with students after one week

Figure 5.2. *Template scripted behavioural PBIS lesson.*

In the below table (Table 5.1.) information is presented regarding: (1) for which behavioural expectations of the final shortlist of 15 behavioural expectations, scripted behavioural lessons (including sequences of examples and non-examples) could already be developed before the summer break of 2021, and (2) by which LS school team this was done. After the summer break lesson development will proceed. The final results and conclusions will be reported in the update of this deliverable (i.e., deliverable D5.3).

Table 5.1.
Developed behavioural lessons by the LS school teams.

Throw trash in the bin	not (yet) chosen
Flush the toilet after your visit	not (yet) chosen
Stand up for others	LS-team of the Meander school
Keep your working space organised	LS-team of the Meander school
Wash (with soap) and dry your hands	not (yet) chosen
Sit while you eat/drink	not (yet) chosen
Help others with questions	LS-team of the Bloeiwijzer school
Store your belongings	LS-team of the Bloeiwijzer school
Greet others	not (yet) chosen but (non-)examples ready
Work independently at your desk	LS-team of the Attendiz school
Keep your hands/feet to yourself	not (yet) chosen
Use stop/ talk/ walk to solve problems	LS-team of the Meander school
Let others be (let others play)	LS-teams of the Attendiz & Bloeiwijzer school
Walk with a goal	not (yet) chosen but (non-)examples ready
Keep doors open for others	not (yet) chosen

Following the discussions with the LS teacher teams, it became apparent that not all of the 15 behavioural expectations of the final shortlist of behavioural expectations were deemed highly relevant for students at grade level 5 and 6. Moreover, based on these discussions the SVU research team tentatively listed

the order of the behavioural expectations for the lesson series to be included in the ARETE pilot 3. The tentative lesson series order is as follows (see Table 5.2.):

Table 5.2.
Tentative final shortlist of behavioural expectations and the order within the lesson series.

General/all settings	1. Greet others
	2. Keep your hands/feet to yourself
	3. Walk with a goal
Classroom setting	4. Keep your working space organised
	5. Store your belongings
	6. Work independently at your desk
Social skills/all settings	7. Stand up for others
	8. Use stop/ walk/ talk to solve problems (a)
	9. Use stop/ walk/ talk to solve problems (b)
	10. Use stop/ walk/ talk to solve problems (c)
	11. Help others with questions
	12. Let others be (let others play)

The sequences of examples/ non-examples for these 12 lessons can be found in Annex D (note: development process is still ongoing, final results and conclusions will be presented in the update of this deliverable [i.e., deliverable D5.3]). The short descriptions (i.e., the sequences of examples/ non-examples) form the basis for creating the technological affordances in terms of AR behavioural expectations that will be used within the AR behavioral lessons. In terms of development, the augmentation process will be based on these descriptions thereby allowing for the creation of 3D objects that can be used by teachers to compose AR learning scenarios that will allow them to show examples or non-examples of the final shortlist of expected behaviours. A preliminary description of an AR scenario has been provided in section 4.3 of D3.1[3]. The complete description of design of the scenarios for the AR implementation will be included in the update of this deliverable (i.e., deliverable D5.3).

An example of a scripted behavioural lesson is presented in Figure 5.2. depicted underneath.

[3] https://drive.google.com/file/d/1-wxCwQ-j1l_gI6Hl79iAJtS6u3spw7I5/view?usp=sharing

(Schoolwide) Behavioural expectation: KEEP YOUR WORKING SPACE ORGANISED
This entails the following specific behaviour:

- Your working space is clean.
- Your working space is organised.
- In your working space you have only the things you need at that moment.

Setting: Classroom setting

Lesson objective: I am keeping my working space organised

Subgoals:

- I know what a working space is.
- I know that a tidy working space is organised and clean.
- I know when a working space is clean.
- I know how to tidy and clean my working space.
- I know why it is nice to have an organised and clean working space.

PBIS value: Responsible and Safe

Starter/prompt/remind
Short and tangible, attract attention by showing/telling (approx.1 minute)
Two student desks are in front of the classroom: one tidy and clean desk and one untidy and unclean desk. One student is behind the tidy desk with an organised working space. Teacher is behind the untidy desk and plays out what the consequences are of an untidy working space. Do you have a pen for me? Talking out loud the teacher searches for a functional object (e.g. a pen or ruler etc.) when seated at the untidy table and takes ages to find the object. As opposed to the student who immediately picks up a pen from his desk.

Teach: instruct and explain **Specify student behaviours**
Includes stating lesson objectives and making it visible. Underlying principle: shared responsibility for a safe and effective school environment endorsed by all (staff, students, and parents)
Teacher: today we are learning how to make and keep our working space organised and tidy. What does that mean?: clean, cleared up and tidied. Why is this important? Our things stay clean and fresh. It is nicer and in this way you can spend more time on your work, because clutter distracts. You can also concentrate on what you need to do when you are sitting at an organised working space. This is not only important for you as students, but also for me as a teacher. For example: teacher models by storing his textbook in the bookcase. And asks the students: What did you see me do? Why did I do this? Teacher states how this relates to the values of the school and/or the values of respect, responsibility, and safety.

Modeling
Teacher models expected behaviour: 3 x example behaviour, 1x non-example behaviour
There are two student desks in front of the classroom: one tidy and clean one and one untidy and unclean one. 1. Teacher shows the tidy and organised desk. Teacher calls out all the things they need for the math lesson and only takes out the math things out of their drawer underneath his desk effortlessly and easily. They put the math things on their desk. 2. Teacher shows the untidy and unorganised desk. They call out the math things necessary for the math lesson and take all the stuff out of their bulging drawer. When the teacher finally finds the math things, the desk is full with the stuff from their drawer. Teacher discusses: Is this a tidy and organised working space? Why not? Why is this a nuisance? Why is this frustrating? How can we tidy this desk in order to have an organised working space? 3. Teacher models how to organise an untidy working space. Subsequently the teacher takes out the right things for the math lesson on the desk. 4. Teacher shows the tidy and organised working space on the desk. The teacher calls out that they are going to take the things for the math lesson out of their drawer and only takes out these things effortlessly and puts them on the desk ready for the math lesson.

Practice
A set of evidence-based interventions and strategies used to teach, supervise and monitor both non-classroom and classroom settings.
Teacher shows the organised working space on the desk: a well organised drawer, a clean table top, not too many things on the desk. Teacher asks students: who is proud of their working space and drawer? Who wants to show it? Take a look at some desks/drawers to discuss. Teacher discusses with students: how is this desk/drawer organised? What are the benefits of this and that? Collaboratively cleaning and sorting out the desks and drawers. Each student cleans and organises their desk and drawer. Students help each other where necessary. If possible use an active structure to organise this. When ready, students take a picture of their clean desk and upload this to the school cloud in a designated space . Teacher collects the pictures. Alternative: include a competition element to make the practice more attractive.

Reflection/review
Attainment of the lesson objective is evaluated with students: • *give the students feedback (praise appropriate behaviour and identify problems)* • *solicit student feedback: "How did we do on xxxxxx today?*

- *deliver consequences as necessary*

Statement on the blackboard/digital board:
I think my working space/desk/drawer is tidy, clean and organised now.
Students keep their drawers closed and respond by thumbs up, down, or horizontal. After this students open their drawer: is it right?

Statement on the blackboard/digital board:
I think I can keep my working space/desk/drawer tidy, clean and organised.
Students respond with the thumbs.
What is necessary to do this? Discuss with students.

Teacher makes a checklist on the blackboard/whiteboard: When do we call your working space/ desk/ drawer tidy?

- organised
- clean
- only the things you need

….
Hang the checklist in the classroom. Illustrate with a picture of a clean and tidy desk and include the appropriate value and behavioural expectation.

Acquirement and retention

Post-lesson: call attention to or practice behavioural expectation daily during one week

Build in checks and fade them out:
Day 1: after each lesson - is your working space/desk/drawer still tidy, organised and clean?
Day 2 and 3: after each break – is your working space/desk/drawer still tidy, organised and clean?
Day 5: start or end of the school day – is your working space/desk/drawer still tidy, organised and clean?
Collect examples by taking photos of the working spaces / desks / drawers (tidy and untidy) within the classroom, but also of working spaces outside of the classroom. Post them on the digital board or whiteboard. If a desk of a student is not tidy/clean, discuss with the student whether it can be posted on the digital board/white board. If necessary also post photos of untidy desks/drawers found on the internet.

Make a game with the class: is it tidy or not tidy?

Evaluation

Post-lesson: evaluate learned behaviour with students after one week

Daily collect data of tidy working spaces / desks/ drawers. Monitor the data in a graph. Give tokens or rewards daily to the students. by placing them on the desks. After a week the data in the graph

are discussed with the class. How do you experience it by having a tidy working space / desk / drawer? How do you keep it that way? Discuss shortly with the students.

Figure 5.2. *An example of a scripted behavioural PBIS lesson.*

6. Pilot 3 — Requirements, design, and data management plan

6.1. Introduction

Within the broader ARETE project, work package 5 (WP5) aims to develop and evaluate the effectiveness of AR solutions that can be embedded within the context of the PBIS-framework. As described in previous sections, the content research and development of the PBIS-AR application and intervention program were part of tasks 5.1 and 5.2 within the ARETE WP5. Following the development of the PBIS-AR application and intervention program, ARETE pilot 3 will be executed to investigate whether AR can successfully be used as a tool to enrich PBIS (i.e., the PBIS-AR application). Specifically, pilot 3 will evaluate the incremental value of integrating AR contents within the PBIS-framework in: (1) proximately promoting student learning of expected positive behaviours in line with established school values, and (2) ultimately promoting students' social, emotional, and cognitive behavioural (self-) management and development (e.g., [pro-]social behaviour, well-being, and executive functioning).

6.2. Pilot 3 — Requirements

The ARETE pilot 3 requirements—stakeholder requirements, intervention study requirements (Consort flow diagram), and ethics requirements—are presented in Chapter 6.2.1 through 6.2.3.4.

6.2.1. Pilot 3 — Stakeholders' requirements

For the ARETE pilot 3, Dutch primary schools that have implemented PBIS at their school will be recruited through the PBIS Netherlands and Europe networks, as well as via the network of the researchers at SVU. Inclusion criteria for schools is implementation of PBIS for more than one school year with fidelity (i.e., 80% buy in of teacher team and good scores on the Tiered Fidelity Inventory [Algozzine et al., 2019]). After headmasters and schools' administration have provided agreement to participate in the pilot study, participants (i.e., students and their parents/ guardians, teachers) will be recruited through an active informed consent procedure (i.e., information letters and consent forms; see Chapter 6.2.3.1 and 6.2.3.2). A pilot study will also run in a PBIS school in Palermo (Italy) that fulfills these inclusion criteria.

Participants need to fulfill the following profile for inclusion in pilot 3: (1) participating students are fifth and/ or sixth grade students (i.e., age range: 9-12 years) at a PBIS school with more than one year of experience in implementation

of PBIS, (2) participating parents/ guardians of these students, and (3) participating teachers working at a PBIS school with more than one year of experience in implementation of PBIS that teach in a participating fifth or sixth grade classroom. Finally, classrooms participating in pilot 3 in the PBIS-AR intervention condition will be provided with suitable (portable) devices and broadband to ensure the intervention can be executed properly.

6.2.2. Pilot 3 — Consort flow diagram

The Consort flow diagram for the ARETE pilot 3 can be found as annex F.

6.2.3. Pilot 3 — Ethics requirements

The full ARETE project—including pilot 3—has been reviewed by the External Ethical Advisory Board (EEAB) as shown in D2.7 (Annex 2).

6.2.3.1. Pilot 3 — Information sheets

The information letters for the ARETE pilot 3 can be found as annex G.

6.2.3.2. Pilot 3 — Consent Forms

The consent forms for the ARETE pilot 3 can be found as annex H.

6.2.3.3. Pilot 3 — Record of Processing Activities (RoPA)

The Record of Processing Activities (RoPA) for the ARETE pilot 3 can be found as annex I.

6.3. Pilot 3 — Recruitment and engagement with stakeholders

In line with the original ARETE project proposal, the ARETE pilot 3 is planned to be evaluated in a sample of 30 fifth and/ or sixth grade primary school classrooms in the Netherlands. Students (i.e., age range: 9-12 years) and teachers of these classrooms would participate in the intervention study. Student, parent/ guardian, and teacher data would be collected before and after the 3-month intervention period. With an expected average classroom size of 25 students, the total sample was expected to consist of approximately 750 fifth and sixth grade primary school students and parents/ guardians, as well as at least 30 teachers. These samples will be equally divided over three experimental conditions (see chapter 6.4 for the

experimental design of the ARETE pilot 3), that is there will be three experimental conditions with 250 fifth and sixth grade students (and their parents/ guardians) and at least 10 teachers each.

The SVU team has recruited Dutch PBIS primary schools to participate in the ARETE pilot 3 study through information letters and information meetings sent out through the Dutch PBIS network. Currently, 6 Dutch primary schools working with schoolwide PBIS have agreed to participate in the pilot 3 study. From three of these schools two teachers of each school are already actively involved in the development of the PBIS behavioural lessons. Further recruitment for more schools will be taken up in September 2021. After the summer break, the students (and their parents/ guardians) and teachers that will participate in the PBIS21 condition (see chapter 6.4 for more information) will be recruited through information letters (see chapter 6.2.3.1) and information meetings held at the participating schools. All participants will have to provide their active informed consent (see chapter 6.2.3.2) for participation in the pilot 3 study. A similar procedure will be used at the start of school year 2022-2023 for sample recruitment of the PBIS22 and PBIS-AR conditions of the pilot study. The full recruitment process will be described in the update of this deliverable (i.e., deliverable D5.3).

6.4. Pilot 3 — Design

Originally, a pre-/ post-test control group design was planned to be used in the ARETE pilot 3 to test the effectiveness of the implementation of a PBIS enriched with AR intervention (i.e., PBIS-AR condition) compared to the implementation of a comparable but traditional PBIS intervention (i.e., PBIS condition) as well as to a control condition with care as usual (i.e., non-PBIS or control condition). This experimental design and the intervention were planned to run during the school year of 2021-2022. Student, parent/ guardian, and teacher data would be collected before and after the 3-month intervention period.

The outbreak of the COVID-19 pandemic caused considerable delays in the execution of the research and development phases of the PBIS-AR intervention part of ARETE WP5 tasks 5.1 and 5.2 (see previous sections). As a result, a contingency plan was developed to guarantee successful execution of pilot 3 despite these delays. While schools in the Netherlands are planned to be fully re-opened in the school year of 2021-2022, this first post-pandemic school year (i.e., after two school years of school closures and online/ hybrid teaching and learning environments) is expected to be clouded by an adjustment phase in which students need to get re-adjusted to a normal teaching and learning environment. Therefore, the design of the pilot 3 intervention needed to not only need to take

the delays in the execution of pre-intervention tasks in WP5 into account, but also the potential confounding effects of school re-adjustment on intervention effectiveness on student learning.

Within the contingency plan, the research and development phase of the PBIS-AR application could continue as planned. However, to account for project delays and student re-adjustment, the ARETE PBIS behavioural lessons are developed to be used during the intervention period of pilot 3 for both the traditional and the AR-enriched PBIS conditions. Furthermore, the experimental design was slightly changed to not only allow for the investigation of the effectiveness of the PBIS-AR intervention, but also of the potential influence of the post-pandemic re-adjustment on student behaviour and learning. That is, the pilot was changed to be spread out over two school years (i.e., 2021-2022 and 2022-2023). As a result, the control (or non-PBIS) condition planned in the original pilot 3 was replaced with an additional traditional PBIS intervention condition in the adjustment school year of 2021-2022. In the new pilot 3, a pre-/ post-test control group design is still planned to test the effectiveness of the implementation of a PBIS enriched with AR intervention in school year 2022-2023 (i.e., PBIS-AR condition) compared with the implementation of a content-similar traditional PBIS intervention in school year 2022-2023 (i.e., PBIS22 condition) as well as compared with the implementation of a content-similar traditional PBIS intervention in the adjustment school year 2021-2022 (i.e., PBIS21 condition). In this new pilot design, it is possible to test for the effectiveness of the PBIS-AR intervention (i.e., PBIS-AR vs. PBIS22) as well as the potential effect of re-adjustment to normal school life on student behaviour and learning (i.e., PBIS21 vs. PBIS22). At the same time, the new pilot 3 design freed up extra time within the project to properly develop the PBIS-AR application.

6.4.1. Pilot 3 — Stakeholders' training

The lesson series which is currently being developed in the LS (see Chapter 5), will include scripted lesson plans for all behavioural lessons that teachers will give during the intervention period of the ARETE pilot 3. These lesson plans will guide teachers in how to execute the lesson series as intended and as such will serve as the main input for the stakeholders' training for the pilot 3 study. The development of the lesson series—including lesson plans—for the non-AR conditions of the pilot 3 intervention (i.e., the PBIS21 and PBIS22 conditions) is still ongoing and will be finalised after the summer break. The development of the lesson series—including the lesson plans—for the AR condition of the pilot 3 intervention (i.e., the PBIS-AR condition) can only start when both the non-AR lesson series and the full set of AR objects have been developed. Development of the lesson series with AR is currently planned for the first half of 2022. Final results and conclusions with

regards to stakeholders' training for the ARETE pilot 3 (i.e., for all experimental conditions) will be included in the update of this deliverable (i.e., deliverable D5.3).

6.4.2. Pilot 3 — Intervention strategy

The Intervention Strategy for the ARETE pilot 3 can be found as annex J.

6.4.3. Pilot 3 — Intervention assessment

The intervention assessment strategy for the ARETE pilot 3 can be found as annex K.

6.4.4. Pilot 3 — Evaluation strategy

The evaluation strategy for the ARETE pilot 3 can be found in the bottom rows of the intervention assessment strategy document (see chapter 6.4.3).

6.4.4.1. Pilot 3 — Measurement tools

The measurement tools are described in the assessment strategy document. All measurement tools used in the ARETE pilot 3 can be found in the ARETE P3 - 6.3 PBIS AR Measurement tools folder[4].

6.4.5. Pilot 3 — Pilot coordination and risk management

Based on the risk analysis for Pilot 2, as described in Table 6.1 and 6.2, the pandemic potentially has a high impact on the intervention part of the Pilot 3 study. Considering that Pilot 3 is planned to be delivered in real-life school settings, contingency options have been considered to ensure Pilot 3 can be executed in all risk scenarios.

[4] https://drive.google.com/drive/folders/1izL2Pi4Ip_ZoAlHnJPYwi5ALD8fuRont

Table 6.1.
Risks acceptability.

	Probability (P)		
Impact (I)	1 (Low)	2 (Medium)	3 (High)
1 (Low)	**Acceptable Risk**	**Acceptable Risk**	**Acceptable Risk**
2 (Medium)	**Unacceptable Risk**	**Unacceptable Risk**	**Unacceptable Risk**
3 (High)	**Unacceptable Risk**	**Unacceptable Risk**	**Unacceptable Risk**

Table 6.2.
Critical risks for implementation.

Risk Description	**Proposed risk-mitigation measures**
COVID-19 Impact on Pilot's teachers' recruitment and Interventions. Initial Risk estimation: P=2 and I=3	Pilot 3: P=3 and I=3 Due to its content (i.e., student [social] behavior), Pilot 3 is highly dependent on the intervention taking place in a real-life or hybrid learning environment. However, contingency options will be considered to ensure Pilot 3 can be executed in all risk scenarios. Regardless of the targeted solution, delays in intervention development (app and curriculum) and pilot study, we plan to overcome the risk of low recruitment of participants (teachers, students and parents) through broadening the deployment of the intervention from Netherlands and Italy (initially targeted countries) to include more participants from other EU countries, through the existing SVU collaboration with the PBS Europe network.

Insufficient assessment (pre and post) due to COVID-19 lockdown. Initial risk estimation: P=3 and I=3	Pilot 3: P=3 and I=3 In case of full lockdown (i.e., schools remain closed), the intervention in a real life school setting or hybrid environment cannot be deployed. As a consequence, the focus of assessment will be directed solely on app usability and user experiences while cognitive (e.g., executive functions such as behavior/emotion regulation) and behavioral (e.g. prosocial behavior) effects will be dropped. The pilot 3 in this case will be based on training of teachers in the use of the PBIS-AR app.

6.5. Data Management Plan (DMP)

ARETE pilot 3 is aligned with the ARETE Data Management Plan (DMP), which is a formal document and has been submitted under deliverable D2.3 in month 6 of the ARETE project. The document specifies how research data will be handled both during and after the pilot 3 study is executed. The DMP is updated over time with the periodic evaluation/ assessment of the ARETE project. The timetable defined by the consortium indicates updates/ review at month 18 (i.e., D2.9) and month 36 (i.e., D2.10) of the ARETE project.

Furthermore, the data workflow diagram for pilot 3—which is based on the Pilot 3 DPIA document—provides a clear overview of data sets, inclusion of new data sets, data providers, data controllers, and data processors. The research data will be deposited to the H2020 ARETE project data repository[5], ZENODO community[6], and Argos (provided from OpenAIRE)[7]. third parties can freely access, mine, exploit, reproduce, and disseminate the data provided. The data flow diagrams for the ARETE pilot 3 can be found as annex L.

[5] https://arete.ucd.ie/
[6] https://zenodo.org/communities/augmented/
[7] https://argos.openaire.eu/

7. Conclusions

The aim of this report was to capture and define the requirements for the development of AR for teaching values and expectations within the framework of PBIS. The report described the research and design process that resulted in the identification of a set of school values and behavioural expectations that will be addressed in the PBIS-AR application to support students' learning of shared values and expected behaviour within the well-validated SWPBIS framework with the aim of promoting students' self-management and self-regulatory skills in school settings.

The report started with a brief overview of PBIS in school settings to help readers better frame the theoretical framework guiding the development of the AR-solution for Pilot 3 (i.e., Chapter 2). Following this introductory note, the report focused on describing:

1. The research and development process that resulted in the identification of PBIS content and requirements guiding the development of the PBIS-AR application (i.e., Chapter 3);
2. The results of a scoping review which addressed the state of the art of interventions integrating AR solutions to teach/train behavioural social skills (i.e., Chapter 4);
3. The description of the LS methodology followed to design a series of behavioural lessons targeting the awareness of expected behaviour and the acquirement of self-management and self-regulatory skills needed in PBIS-settings (i.e., Chapter 5);
4. The description of the requirements for Pilot 3 in terms of research design (design, participants, measures, assessment, and intervention strategy; i.e., Chapter 6).

Despite unexpected project delays due to the emergence of the COVID-19 pandemic, the work executed in the ARETE WP5 tasks 5.1 and 5.2 has resulted in pedagogical content to be included in the PBIS-AR application which is currently under development. Following literature review and—quantitative and qualitative—data collection, a final shortlist of behavioural expectations for the PBIS-AR application were defined based on the universal school values of respect, responsibility, and safety. Starting from the final shortlist of behavioural expectations, a set of behavioural lessons is currently being developed for the ARETE pilot 3. This process is still ongoing and final results will be presented in the update deliverable D5.3. However, the final list of behavioural lessons that will be included in the ARETE pilot 3 is presented in Table 5.2, including the tentative lesson order within the pilot study.

Besides the behavioural lessons that will be part of the ARETE pilot 3, the work executed in WP5 also converged on the reinforcement systems to be implemented in the PBIS-AR application to stimulate students' adherence to learned expected behaviours. Students will practice the learned expected behaviours during the pilot 3 intervention by making short videos of each others' performance. These performances will subsequently be rated by other students and by the teacher. Good performance will be rewarded through visual reinforcement. Specifically, a combination of leaderboards, badges, and point systems will be implemented in the PBIS-AR application.

The state of art suggests promising findings about the opportunity to use AR-based treatments for the promotion and support of social skills in children and adolescents with special needs. The ARETE pilot 3 extends to students the use of AR for training purposes and rigorously validates the use of AR technology in the context of mainstream education. In particular since no research has been done on the impact of AR solutions for the promotion of students' outcomes at a schoolwide level and/ or from a prevention perspective, pilot 3 investigates the use of AR as a prevention support tool for teaching and learning behavioural expectation within SWPBIS. From a technological advancement perspective most of the study shows the use of marker-based technology in their solution. Considering that SWBPIS is a context-based framework where behavioural expectations strictly depend on actual school settings, pilot 3 conceives a marker-based technology that overcomes marker-less solutions and allows the positioning of AR contents on the basis of environment recognition. In this way the AR behavioural expectations are composed and played on the specific context where they are needed.

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Annex A

Introduction

Positive Behaviour Intervention & Support in Europe (PBIS-E) Questionnaire

What is the PBIS-E questionnaire about?
The goal of this questionnaire is to capture the critical features of Schoolwide Positive Behaviour Intervention and Support (PBIS) across the academic school year of 2020/2021 in European primary schools.

The questionnaire is used to take stock of: (1) the implementation of PBIS in terms of school values, behavioural expectations, and reinforcement of appropriate behaviour, (2) the potential influence of the COVID-19 pandemic and changes in teaching environment (i.e., from face-to-face to online-only or blended teaching) on PBIS teaching, and (3) the use of emergent technologies, like Augmented Reality (AR), in PBIS teaching.

Raffle
Amongst all teachers who have filled in the digital questionnaire, we will raffle 20 Amazon gift cards of 10 pounds.

Active informed consent
I have read the information regarding the PBIS-E questionnaire. I understand what it means to consent with participation in this research and I have had enough time to decide about my consent. I was able to ask questions and potential questions have been answered. I voluntarily consent with participation in this research and am aware of my ability to revoke my consent at any time during or after the research, without substantiating reasons. I am aware that the researchers mentioned are allowed to view my anonymous data for research purposes. I understand that my data will be treated confidentially and anonymously for research purposes, and that the data and published results cannot be traced back to me personally.

- ○ *I have read the information and I consent to participation in this project*

General instructions
Please complete the questionnaire independently. The questionnaire consists of five parts: (1) background information, (2) school values and behavioural expectations, (3) the influence of the COVID-19 pandemic on your PBIS teaching, (4) reinforcement of appropriate behaviour, and (5) using AR in your (PBIS) teaching.

Schedule 20 minutes in to complete the questionnaire. Base your answers on your individual experiences in your school. If you do not work in classrooms, answer questions that are applicable to you. There are no right or wrong answers and you are free to stop answering the questions in the questionnaire at any point in time—without indicating why—by closing the webpage on which the questionnaire is presented.

PART 1 — Background information

PART 1 — Background information
We would like to start by asking some general background questions about your school and (the implementation of) PBIS in your school.

What is your gender?
- ○ Male
- ○ Female
- ○ Other

How old are you?

What is your role in your school?

- Administrator
- Teacher
- Educational or teacher assistant
- Remedial teacher
- Counsellor
- School psychologist
- Other, namely:

How would you classify your school?

- Primary school
- Special (primary) school
- Other, namely:

How many students are there (roughly) in your school?

What percentage of students in your school can be classified as special needs students (i.e., students with additional educational or behavioural needs that require extra/specialized services/attention)?

What is the average number of students per classroom in your school?

When did your school start with the implementation of PBIS?

Did your school receive team training in PBIS?

- Yes
- No

Is there a PBIS leadership team in place in your school?

- Yes
- No

What is the degree of PBIS implementation fidelity (the implementation of PBIS as intended)?

- Percentage:
- I don't know

Are you receiving ongoing PBIS support by a trained coach?

- Yes

- No

PART 2 — PBIS in European primary schools: Values and expectations

PART 2 — PBIS in European primary schools: Values and expectations

We would like to know more about the school values and behavioural expectations that are installed in PBIS primary schools throughout Europe.

There are no right or wrong answers, we simply want to know the situation in your school.

Did your school agree on a set of school values?

- Yes
- No

How many school values?

What are the agreed upon school values for your school?

Please indicate for the following school values how important they are in your school:

	Very unimportant 1	2	3	4	Very important 5
Respect:					
Responsibility:					
Safety:					

Did your school agree on a set of behavioural expectations?

- Yes
- No

How many behavioural expectations?

	How many?
Schoolwide:	
In the classroom:	
In other settings (e.g., hallway, restroom, playground):	

Are expected student behaviours both positively stated and clearly defined?

All	Most	Some	None

Are expected student behaviours taught to students directly?

All	Most	Some	None

Are expected student behaviours rewarded?

All	Most	Some	None
○	○	○	○

Are expected student behaviours positively reinforced (i.e., >4 positives to 1 negative)?

All	Most	Some	None
○	○	○	○

Are problem behaviours (i.e., failures to meet expected student behaviours) defined clearly?

All	Most	Some	None
○	○	○	○

Are the consequences for problem behaviours defined clearly?

All	Most	Some	None
○	○	○	○

Are the consequences for problem behaviours reinforced?

All	Most	Some	None
○	○	○	○

Please indicate for the following behavioural expectations how important they are in your school: (a) Schoolwide, (b) In the classroom, and (c) In other settings (e.g., hallway, restroom, playground).

Walk purposefully (walk with a goal)

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Keep doors open for others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Greet others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Please indicate for the following behavioural expectations how important they are in your school: (a) Schoolwide,

(b) In the classroom, and (c) In other settings (e.g., hallway, restroom, playground).

Throw rubbish in the bin

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Wash (with soap) and dry your hands

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Sit while you eat/drink

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Please indicate for the following behavioural expectations how important they are in your school: (a) Schoolwide, (b) In the classroom, and (c) In other settings (e.g., hallway, restroom, playground).

Keep your hands/feet to yourself

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Use stop/walk/talk to solve problems

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Keep your working space organised

	Very unimportant				Very important
	1	2	3	4	5

Schoolwide:					
In the classroom:					
In other settings:					

Please indicate for the following behavioural expectations how important they are in your school: (a) Schoolwide, (b) In the classroom, and (c) In other settings (e.g., hallway, restroom, playground).

Store your belongings

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other settings:					

Let others be (let others play)

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other settings:					

Help others with questions

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other settings:					

Please indicate for the following behavioural expectations how important they are in your school: (a) Schoolwide, (b) In the classroom, and (c) In other settings (e.g., hallway, restroom, playground).

Stand up for others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other settings:					

Work independently at your desk

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					

In other settings:	○	○	○	○	○

Flush the toilet after visit

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other settings:	○	○	○	○	○

Are there other behavioural expectations that are important in your school that are not included in the presented list?

1. Walk purposefully (walk with a goal)
2. Keep doors open for others
3. Greet others
4. Throw rubbish in the bin
5. Wash (with soap) and dry your hands
6. Sit while you eat/drink
7. Keep your hands/feet to yourself
8. Use stop/walk/talk to solve problems
9. Keep your working space organized
10. Store your belongings
11. Let others be (let others play)
12. Help others with questions
13. Stand up for others
14. Work independently at your desk
15. Flush the toilet after visit

Please describe the behavioural expectation(s) including a short description of how it is commonly used in your school.

Which situation is the most important situation for students to learn the behavioural expectation "Store your belongings"?

- ○ Storing/hanging jacket and/or backpack
- ○ Storing/putting away school equipment in the classroom
- ○ Both are equally important
- ○ Another situation, namely:

PART 3 — PBIS in European primary schools: COVID-19 pandemic influences

PART 3 — PBIS in European primary schools: COVID-19 pandemic influences

We would also like to know more about your PBIS teaching during COVID-19. Many countries faced (partial) lockdowns during the pandemic, forcing teachers to move their teaching from a face-to-face to an online or blended (part online, part face-to-face) teaching environment. Has this change in teaching environment impacted your PBIS teaching?

Again, there are no right or wrong answers. We simply want to know what strategies you may have used to adjust your teaching to this changed teaching environment.

Has there been a (partial) lockdown in your country?

- ○ Yes
- ○ No

Has the (partial) lockdown impacted your teaching environment?

- ○ Yes, my teaching environment changed into online teaching

- Yes, my teaching environment changed into blended teaching
- No, my teaching environment was unaffected

Has the change in teaching environment forced you to adjust the behavioural expectations you teach to your students?

- Yes
- No

What adjustments have you made in the behavioural expectations you teach to your students?

Can you briefly describe how you teach your behavioural lessons in this online or blended teaching environment (what changes have you made)?

How has your attitude towards using emergent technologies in your teaching changed due to the pandemic?

	Became less positive				Became more positive
	1	2	3	4	5
	○	○	○	○	○

Can you briefly elaborate on this rating?

PART 4 — Behavioural reinforcement of appropriate behaviour

PART 4 — Behavioural reinforcement in real-life and online environments
We would also like to know more about how you reinforce (or reward) students' appropriate behaviour, both in real-life and in online educational environments. Online environments refer to both online or remote teaching via video-calling and/or to applications/games to support teaching that can be used on mobile devices.

Again, there are no right or wrong answers. We simply want to know what you use in your teaching to reinforce appropriate behaviour and what you think would work best to reinforce appropriate behaviour in online and virtual environments.

How do you reinforce appropriate behaviour of your students in your PBIS teaching in face-to-face teaching context?

How do you reinforce appropriate behaviour of your students in your PBIS teaching in online teaching context?

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

1. Badges are visual icons that signify achievements accomplished by users.
Examples: Trophies, Medals, Stamps, Icons, Awards.

Use:

	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

2. Points are numerical units that are obtained by completing an activity and/or action.
Examples: Experience Points, Loyalty Points, Reputation Points, Scores.

Use:

	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

3. Leaderboards allow users to compare their own performance with others' performance.
Examples: Rankings, High-Score tables, Scoreboards, Line Chart.

Use:

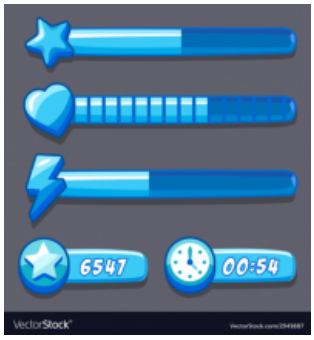
	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

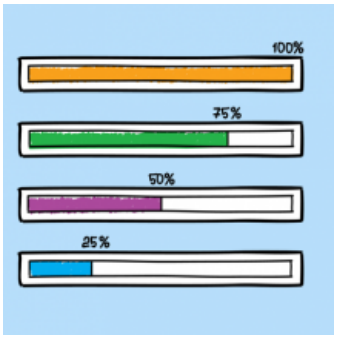
Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

4. Progress Bars are used to indicate users' progress, without comparing one user's performance to those of other users.
Examples: Progress/performance Bars/Graphs/Stars, Progress Notifications.





Use:

	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

5. Virtual goods are assets with a perceived value that can be purchased or traded online (e.g., in a game).
Examples: goods/gifts to customize your User Profile or Avatar.

Use:

	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

For the following six reinforcement systems, can you indicate (a) to what extent you use them in your PBIS teaching, and (b) how effective you think they are in rewarding expected behaviour?

6. Tokens are tradeable objects that can be exchanged for physical rewards or activities in school.
Examples: Food, Extra (Computer) Time.

Use:

	Never				Always
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

Effectiveness:

	Very ineffective				Very effective
	1	2	3	4	5
In face-to-face teaching:	○	○	○	○	○
In online teaching:	○	○	○	○	○

PART 5 — Requirements for supporting (PBIS) teaching with Augmented Reality

PART 5 — Requirements for supporting (PBIS) teaching with Augmented Reality
Finally, we would like to know more about your experience with using Augmented Reality (AR) in your teaching and your expectations of using AR in your PBIS teaching.

What is AR? With AR it is possible to add an extra layer to what we see in real life through a mobile device. For example, a student scans a (picture of a) water tap and the mobile device visually enriches the water tap with a teaching experience for the student of the behavioural expectation "wash your hands with soap".

Again, there are no right or wrong answers. We simply want to know what is needed to support your PBIS teaching with AR.

How many devices does your school provide to support your teaching with AR?

	How many?
Smartphones:	
Tablets:	

Desktops with webcam:	
Laptops with webcam:	
Other devices, namely:	

Have you ever used AR in your teaching?

- Yes
- No

Which hardware have you used for teaching with AR? (choose all that apply)

- Smartphones
- Tablets
- Desktops with webcam
- Laptops with webcam
- Game console
- Other devices, namely:

How often do you use AR in your teaching?

- Daily
- Weekly
- Monthly
- Yearly
- Other, namely:

How much do you like to use AR in your teaching?

	Dislike very much				Like very much
	1	2	3	4	5
	○	○	○	○	○

What do you like about using AR in your teaching?

What don't you like about using AR in your teaching?

How confident are you currently about using AR in your teaching?

	Very unconfident				Very confident
	1	2	3	4	5
	○	○	○	○	○

Can you briefly elaborate on this rating?

How could your confidence be further improved?

Do you think that AR can be beneficial in teaching behavioural expectations to your students?

	Strongly disagree				Strongly agree
	1	2	3	4	5
	○	○	○	○	○

What positive expectations do you have?

What negative expectations do you have?

End of questionnaire

End of questionnaire
Thank you very much for answering our questions. Your answers are very valuable to us.

A raffle will be held when all participating teachers have filled in the questionnaire. You can win an Amazon gift voucher of 10 pounds!

Please click on the arrow below to close off the questionnaire.

Annex B

Introduction

ARETE

Positive Behaviour Intervention & Support in Europe (PBIS-E) Questionnaire

What is the PBIS-E questionnaire about?
With this questionnaire we want to know two things:

First, what does Positive Behaviour Interventions & Support (PBIS) look like in your school this school year (2020-2021).

What is Positive Behaviour Intervention & Support (PBIS)?
PBIS helps schools to improve school safety and promote positive behaviour in students. The focus of PBIS is on teaching appropriate behaviour like every other subject, such as math. Students can only meet behavioural expectations if they know what the expectations are. Everyone learns what is considered appropriate behaviour and uses a common language to talk about it. Throughout the school day—in class, in the hallway, on the playground—everyone understands what is expected of them.

And, second, how can technology, specifically Augmented Reality (AR), be used to help PBIS in your school.

What is Augmented Reality (AR)?
Augmented Reality (AR) adds extra visual information to what we see in real life through a mobile device. For example, by scanning a water tap with your phone, an animation pops up visualising the behavioural expectation "wash your hands with soap".

Your answers will help us develop a mobile device application (or app) for PBIS in which Augmented Reality (AR) is used to support (your) future PBIS education!

Raffle
Amongst all students who have filled in the digital questionnaire, we will raffle 20 Amazon gift cards of 10 pounds!

Instructions
Please complete the questionnaire by yourself. The questionnaire consists of 4 parts: 1) background information, 2) PBIS school values and behavioural expectations, 3) rewards for appropriate behaviour, and 4) your experience with Augmented Reality (AR).

You should be able to complete the questionnaire in 10-15 minutes. You are free to stop at any point in time—without indicating why—by closing the webpage.

Thank you for taking time to help us out!

PART 1 — Background information

PART 1 — Background information
We would like to start by asking a few background questions about you and your school.

What type of school do you go to?

- ○ Primary school
- ○ Special education primary school
- ○ Other, namely:

How many students are in your classroom?

What is your gender?

- ○ Boy
- ○ Girl
- ○ Other

How old are you?

- ○ 9
- ○ 10
- ○ 11
- ○ 12
- ○ Other, namely:

PART 2 — PBIS in European primary schools: Values and expectations

PART 2 — PBIS in European primary schools: Values and expectations
We would like to continue with a few questions about the PBIS school values and behavioural expectations in your school.

There are no right or wrong answers.

What are the school values in your school?

How important do you think the following three school values are in your school:

	Very unimportant 1	2	3	4	Very important 5
Respect:	○	○	○	○	○
Responsibility:	○	○	○	○	○
Safety:	○	○	○	○	○

Please indicate how important you think the following behavioural expectations are in your school: (a) schoolwide, (b) in the classroom, and (c) in other school areas.

Walk purposefully (walk with a goal)

	Very unimportant 1	2	3	4	Very important 5

Schoolwide:					
In the classroom:					
In other areas:					

Keep doors open for others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Greet others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Please indicate how important you think the following behavioural expectations are in your school: (a) schoolwide, (b) in the classroom, and (c) in other school areas.

Throw rubbish in the bin

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Wash (with soap) and dry your hands

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Sit while you eat/drink

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Please indicate how important you think the following behavioural expectations are in your school:

(a) schoolwide, (b) in the classroom, and (c) in other school areas.

Keep your hands/feet to yourself

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other areas:	○	○	○	○	○

Use stop/walk/talk to solve problems

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other areas:	○	○	○	○	○

Keep your working space organised

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other areas:	○	○	○	○	○

Please indicate how important you think the following behavioural expectations are in your school: (a) schoolwide, (b) in the classroom, and (c) in other school areas.

Store your belongings

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other areas:	○	○	○	○	○

Let others be (let others play)

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:	○	○	○	○	○
In the classroom:	○	○	○	○	○
In other areas:	○	○	○	○	○

Help others with questions

	Very unimportant				Very important
	1	2	3	4	5

Schoolwide:					
In the classroom:					
In other areas:					

Please indicate how important you think the following behavioural expectations are in your school: (a) schoolwide, (b) in the classroom, and (c) in other school areas.

Stand up for others

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Work independently at your desk

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Flush the toilet after your visit

	Very unimportant				Very important
	1	2	3	4	5
Schoolwide:					
In the classroom:					
In other areas:					

Are there other important behavioural expectations in your school that we did not include in our list of behavioural expectations?

1. Walk purposefully (walk with a goal)
2. Keep doors open for others
3. Greet others
4. Throw rubbish in the bin
5. Wash (with soap) and dry your hands
6. Sit while you eat/drink
7. Keep your hands/feet to yourself
8. Use stop/walk/talk to solve problems
9. Keep your working space organized
10. Store your belongings
11. Let others be (let others play)
12. Help others with questions
13. Stand up for others
14. Work independently at your desk
15. Flush the toilet after visit

Please write them down here:

PART 3 — Rewards for appropriate behaviour and good performance

PART 3 — Rewards for appropriate behaviour and good performance
We would also like to know more about how appropriate behaviour is rewarded in your school and what kind of rewards motivate or stimulate you to perform well (that is, to show appropriate behaviour in PBIS or do well in games).

Again, there are no right or wrong answers.

If you or your classmates show appropriate behaviour, how is this typically rewarded by teachers in your school?

How much do you agree with the following statements?

Competing with others motivates me to show appropriate behaviour in school

	Strongly disagree				Strongly agree
	1	2	3	4	5
	○	○	○	○	○

Competing with others motivates me to perform well in games

	Strongly disagree				Strongly agree
	1	2	3	4	5
	○	○	○	○	○

Earning rewards motivates me to show appropriate behaviour in school

	Strongly disagree				Strongly agree
	1	2	3	4	5
	○	○	○	○	○

Earning rewards motivates me to perform well in games

	Strongly disagree				Strongly agree
	1	2	3	4	5
	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

1. Badges such as trophies, medals, stamps or awards for your performance.

How motivating to get?

	Very unmotivating				Very motivating
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

2. Points such as experience/reputation points or high-scores for your performance.

How motivating to get?

	Very unmotivating				Very motivating
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

3. Leaderboards such as rankings or score boards to compare your performance with those of others.

How motivating to get?

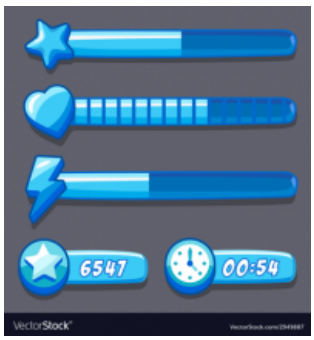
	Very unmotivating				Very motivating
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

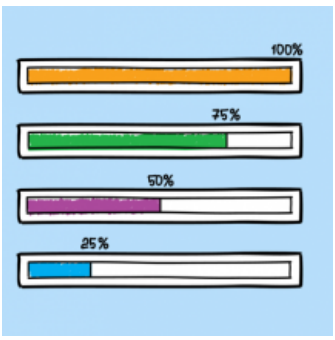
How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

4. Progress bars such as progress/performance bars/stars or progress notifications to see how you are doing.





How motivating to get?

	Very unmotivating				Very motivating
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○

For performing well in games:	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

5. Virtual goods/gifts such as coins that you can win for performing well and thast you can buy things with in the application (app) to customise your *User Profile* or *Avatar.*

How motivating?

	Very unmotivating				Very motivating
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How motivating, and how much fun to receive, is each of the following six types of rewards for (a) showing appropriate behaviour in school and (b) performing well in games.

6. Tokens such as stamps or stickers for your performance that you can trade for real-life rewards or activities in school (e.g., food or computer time).

How motivating?

	Very unmotivating				Very motivating

	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

How much fun to get?

	Not fun at all				A lot of fun
	1	2	3	4	5
For appropriate behaviour in school:	○	○	○	○	○
For performing well in games:	○	○	○	○	○

Are there other types of rewards than the ones listed that motivate you to perform well?

1. Badges
2. Points
3. Leaderboards
4. Progress bars
5. Virtual goods/gifts
6. Tokens

Please write them down here:

PART 4 — Experience with Augmented Reality

PART 4 — Experience with Augmented Reality (AR)

Lastly, we would like to know more about your experience with Augmented Reality (AR) applications (or apps) for learning in school.

Again, there are no right or wrong answers.

What is Augmented Reality (AR)?
Augmented Reality (AR) makes it possible to add extra visual information to what we see in real life through a mobile device. For example, you scan a water tap with your phone and the water tap is shown on your phone with an animation of the behavioural expectation "wash your hands with soap" as a teaching experience.

Have you ever used Augmented Reality (AR) apps for learning in school?

- ○ Yes
- ○ No

How much did you like the Augmented Reality (AR) apps that you used for learning in school?

Dislike very much Like very much

	1	2	3	4	5
	○	○	○	○	○

What did you like about it?

What didn't you like about it?

How much would you like to learn about appropriate behaviour with Augmented Reality (AR)?

Dislike very much Like very much

	1	2	3	4	5
	○	○	○	○	○

What appropriate behaviour would you like to learn with Augmented Reality (AR) the most?

End of questionnaire

End of questionnaire
Thank you very much for answering our questions. Your answers are very valuable to us.

A raffle will be held when all participating students have filled in the questionnaire. You can win an Amazon gift voucher of 10 pounds!

Please click on the arrow below to close off the questionnaire.

Annex C

ARETE

Invitation Letter for School Administrators:
Positive Behaviour Intervention & Support Europe (PBIS-E) Questionnaire

Amsterdam, April 2021.

Dear school administrator of a PBIS-school,

This invitation letter kindly requests your school's participation in a research project called ARETE (www.areteproject.eu).

We would like to ask you to disseminate:
1. an online questionnaire for your teachers, and
2. an online questionnaire for your students aged 9-12 years of age (after collecting active informed consent of the parents/guardians).

What is the research about?
The goal is to capture the critical features of PBIS across the academic school year of 2020/2021 in European primary schools. The online questionnaire for teachers and students (aged 9-12 years) is used to take stock of: (1) the implementation of PBIS in terms of school values, behavioural expectations, and reinforcement of appropriate behaviours, (2) the potential influence of the COVID-19 pandemic and changes in teaching environment (i.e., from face-to-face to online or blended teaching) on PBIS teaching, and (3) the use of emergent technologies, like Augmented Reality (AR), in PBIS teaching.

What is Positive Behaviour Intervention & Support (PBIS)?
PBIS is an approach that helps schools to improve school safety and promote positive behaviour in students. The focus is prevention by teaching behaviour strategies to students, just as they would teach about any other subject, like math. Everyone learns what is considered to be appropriate behaviour and uses a common language to talk about it. Throughout the school day—in class, in the corridors, on the playground—everyone understands what is expected of them.

The results are used to develop an open source mobile application for PBIS aimed at enhancing PBIS teaching by using AR (PBIS-AR). With AR it is possible to add an extra layer to what we see in real life through a mobile device. For example, a student scans a (picture of a) water tap and the mobile device visually enriches the water tap with a teaching experience for the student of the behavioural expectation "wash your hands with soap". The insights gained about PBIS in Europe are shared in conference presentations and/or in (scientific) publications.

Who is executing the project?
Vrije Universiteit Amsterdam (VU; Netherlands) participates in a large European research project funded by the European Committee about AR in education. The VU-team is led by dr. Sui Lin Goei, dr. Jeroen Pronk, and Wilma Jongejan MSc. The ARETE project is coordinated by prof. Eleni Mangina of the University College Dublin. For more information www.areteproject.eu.

Is the research ethically reviewed?
The ARETE project has been reviewed by an independent ethical review board at European level. The PBIS-E questionnaire has been reviewed by the ethical review board of VU.

How will the results of the project be shared with me?
After the research has finished and the results of this research have been published, the results will be emailed to all participating schools to share with their teachers.

What do I need to do?
1. Please let your *country contact* [name and e-mail] know that you agree to participate in this research project by emailing them.
2. Subsequently, information letters for teachers and parents/guardians will be emailed to you for digital distribution to teachers and parents/guardians of children aged 9-12 years.
    a. The email with the *teacher* information letter will contain a link to an online teacher questionnaire. The questionnaire itself contains an anonymized online informed consent form for participation in the research for teachers. You can copy and paste the text of the teacher information letter into an email to send to all teachers.
    b. The email with the *parent(s)/guardian(s)* information letter contains a link to an online consent form. You can copy and paste the text of the information letter for parents/guardians—include also the link to the online consent form—into an email to send to all parents/guardians of children aged 9-12 years.
3. Agree with the home room teachers on a moment for administering the questionnaire to students with active informed consent of parents/guardians.
    a. It is best to leave ±2 weeks between sending the information letter and consent form to parents/guardians and administration of the questionnaire.
    b. It is best to have students fill in the questionnaire on a laptop/computer. Alternatively, in agreement with the parents/guardians, the questionnaire can be filled in at home.
4. Please inform your country contact on the date that the teachers and students will fill in the online questionnaire. Among the filled in questionnaires a raffle will be held and both teachers and students can win an Amazon gift voucher.
    a. You will be provided an email containing a list of students with consent of parents/guardians to fill in the questionnaire as well as a link to the student questionnaire (± 1 or 2 days before administering the questionnaire). The consent name list will be fully digitally deleted by the researchers directly after sending the name list to you to ensure the anonymity of all participating students.
    b. Please share the name list and the questionnaire link with the teachers administering the student questionnaire to students.

Many thanks for your considerations and potential participation in this research.

Sincerely,
Sui Lin Goei, Jeroen Pronk, & Wilma Jongejan

ARETE-VU PBS-AR team
Vrije Universiteit Amsterdam, Netherlands

Information Letter for Teachers:
Positive Behaviour Intervention & Support Europe (PBIS-E) Questionnaire

Amsterdam, April 2021.

Dear teacher at a PBIS-school,

Your school has registered for participation in a research about Positive Behaviour Intervention and Support (PBIS) during the school year of 2020/2021. This letter serves to both inform you about this research and to request your consent for collecting and storing your data within this research.

What is the research about?
Goal is to capture the critical features of PBIS across the academic school year of 2020/2021 in European primary schools. An online questionnaire is used to take stock of: (1) the implementation of PBIS in terms of school values, behavioural expectations, and reinforcement of appropriate behaviours, (2) the potential influence of the COVID-19 pandemic and changes in teaching environment (i.e., from face-to-face to online-only or blended teaching) on PBIS teaching, and (3) the use of using emergent technologies, like Augmented Reality (AR), in PBIS teaching.

What is Positive Behaviour Intervention & Support (PBIS)?
PBIS is an approach that helps schools to improve school safety and promote positive behaviour in students. The focus is prevention by teaching behaviour strategies to students, just as they would teach about any other subject, like math. Everyone learns what is considered to be appropriate behaviour and uses a common language to talk about it. Throughout the school day—in class, in the corridors, on the playground—everyone understands what is expected of them.

The results of this research will be used:

1. to support the development of an open source mobile application for PBIS aimed at enhancing PBIS teaching by using Augmented Reality (AR) animations. With AR it is possible to add an extra layer to what we see in real life through a mobile device. For example, a student scans a (picture of a) water tap and the mobile device visually enriches the water tap with a teaching experience of the behavioural expectation "wash your hands with soap".
2. The insights gained through the questionnaire, will be shared with PBIS professionals during conference presentations and/or in (scientific) publications.

Who is executing the project?
Vrije Universiteit Amsterdam (VU; Netherlands) participates in a large-scale European research project funded by the European Committee about the application

of AR in education (ARETE; www.areteproj.eu). The VU-team is responsible for the PBIS-knowledge and is led by dr. Sui Lin Goei, dr. Jeroen Pronk, and Wilma Jongejan MSc. The VU-team collaborates with Consiglio Nazionale delle Richerche (Sicily, Italy) and the University of Leicester (England, United Kingdom). The larger ARETE project is coordinated by prof. Eleni Mangina of University College Dublin. For more information, please visit www.areteproject.eu.

How will your data be recorded, used and stored?
Data with which you could be personally identified will not be recorded. All data will remain confidential. When you give active consent, you give permission for your anonymous data to be recorded, stored, processed, and used by the researchers mentioned in this information letter. The researchers will store your anonymous data for a period of ten years in a secure digital data storage of the VU. Collected data will only be used and analyzed by the researchers mentioned below to support the development of the PBIS-AR application, for publication in (scientific) journals, and for presentations during (academic) conferences. For all of these purposes, your data will be used anonymously.

Is the research ethically reviewed?
The ARETE project has been reviewed by an independent ethical review board at European level. The PBIS-E questionnaire has been reviewed by the ethical review board of VU.

Who can I contact for questions or complaints?
Please contact the project lead at VU, dr. Sui Lin Goei via e-mail (s.l.goei@vu.nl).

How will the results of the project be shared with me?
After the research has finished and the results of this research have been published, the results will be emailed to all participating schools to share with their teachers.

How can I participate?
If you decide to consent to participation in this research, you can indicate your active consent at the start of the online questionnaire for which you will receive a weblink via your school administrator. For your participation, you have the chance of winning an Amazon gift card of 10 euro through a raffle.

Many thanks for your considerations and potential participation in this research.

Sincerely,
Sui Lin Goei, Jeroen Pronk, & Wilma Jongejan

ARETE-VU PBS-AR team
Vrije Universiteit Amsterdam, the Netherlands

Information Letter for Parents/Guardians and Students:
Positive Behaviour Intervention & Support Europe (PBIS-E) Questionnaire

Amsterdam, [date].

Dear parent/guardian,

The school of your child has registered for participation in a research about Positive Behaviour Intervention and Support (PBIS). This letter informs you about this project and asks for your active consent to collect and store your child's anonymous data within this research.
The consent form can be found following this link [HYPERLINK]. Before you decide about your child's consent, we would like to inform you about the research and what is requested of your child within this research.

What is the research about?
Goal is to capture the critical features of PBIS across the school year of 2020/2021 in European primary schools. An online questionnaire is used to ask your child about two things specifically:

1. what does PBIS look like in your child's school this school year;
2. how technology, specifically Augmented Reality (AR), can be used to teach appropriate behaviour within PBIS.

What is Positive Behaviour Intervention & Support (PBIS)?
PBIS is an approach that helps schools to improve school safety and promote positive behaviour in students. The focus of PBIS is prevention by teaching behaviour strategies to students, just as they would teach about any other subject, like math. Everyone learns what is considered to be appropriate behaviour and uses a common language to talk about it. Throughout the school day—in class, in the corridors, on the playground—everyone understands what is expected of them.

What is Augmented Reality?
Augmented Reality makes it possible to add extra visual information to what we see in real life through a mobile device. For example, you scan a (picture of a) water tap with your phone and the water tap is enriched by your phone with an animation visualizing a teaching experience of the behavioural expectation "wash your hands with soap".

The results of this research are used to develop an AR mobile application for PBIS-teaching (PBIS-AR), and the results are used for (scientific) presentations and/or in (scientific) publications.

Who is executing the project?

Vrije Universiteit Amsterdam (VU; Netherlands) participates in a large European project funded by the European Committee about AR in education (ARETE; www.areteproj.eu). The research and development of PBIS-AR is led by dr. Sui Lin Goei, dr. Jeroen Pronk, and Wilma Jongejan MSc. The VU-team collaborates with Consiglio Nazionale delle Richerche (Italy) and the University of Leicester (United Kingdom). The larger project is coordinated by prof. Eleni Mangina of the University College Dublin. For more information www.areteproject.eu.

Why is my child invited to participate?
Your child is invited to participate because he/she is 9-12 years old and attends a European PBIS primary school. By participating, your child—in return—has the chance of winning an Amazon gift card of 10 euro through a raffle.

How will your child's data be recorded, used and stored?
Data with which your child could be personally identified will not be recorded. All data will remain confidential. When you give active informed consent, you give permission for your child's anonymous data to be recorded, stored, processed, and used by the researchers mentioned in this information letter. The researchers will store your child's anonymous data for a period of ten years in a secure digital data storage of the VU. Collected data will only be used and analyzed by the researchers mentioned below to support the development of the PBIS-AR application, for publication in (scientific) journals, and for presentations during (academic) conferences. For all of these purposes, your child's data will be used anonymously.

Is the research ethically reviewed?
The ARETE project has been reviewed by an independent ethical review board at European level. The PBIS-E questionnaire has been reviewed by the ethical review board of VU.

Who can I contact for questions or complaints?
Please contact the project lead at VU, dr. Sui Lin Goei via email (s.l.goei@vu.nl).

How will the results of the project be shared with me?
After the research has finished and the results of this research have been published, the results will be emailed to all participating schools to share with you.

How can I give consent for my child's participation?
You can indicate your active consent via link [HYPERLINK].
Many thanks for your considerations and potential participation in this research.

Sincerely,
Sui Lin Goei, Jeroen Pronk, & Wilma Jongejan
ARETE-VU PBS-AR team
Vrije Universiteit Amsterdam, the Netherlands

Parent/Guardian Informed Consent form

Positive Behaviour Intervention & Support in Europe (PBIS-E) Questionnaire

I/we have read the information describing the research. I/we understand what the research is about and what taking part means for my/our child. I/we have been given the chance to ask questions and to receive an answer to these questions. I/we have had enough time to decide about allowing my/our child to take part in the research. I/we voluntarily consent to my/our child's participation in the research. I/we have the right to change my/our mind at any time. I/we understand that the researchers mentioned in the information form are allowed to view my/our child's anonymous data for research purposes. I/we understand that my/our child's data will be collected anonymously and treated confidentially for research purposes. This means that no data and/or published results can be traced back to my/our child.

I/we consent to my/our child's participation in this research.	YES:	NO:

_____

Classroom:

_____

Name of child:

_____

Name of parent(s)/guardian(s):

_____

Please press the "SEND" button in the right bottom corner to close this form.

Annex D

ARETE PBIS-AR behavioural Expectation Scenarios short description

For the following behavioural expectations scripted behavioural lessons are being developed by the LS-teams, including the sequence of examples and non-examples (development process ongoing, planned to be finalised after summer break of 2021 and to be updated in deliverable D5.3.):

General/all settings	1. Greet others
	2. Keep your hands/feet to yourself
	3. Walk with a goal
Classroom setting	4. Keep your working space organised
	5. Store your belongings
	6. Work independently at your desk
Social skills/all settings	7. Stand up for others
	8. Use stop/ walk/ talk to solve problems (a)
	9. Use stop/ walk/ talk to solve problems (b)
	10. Use stop/ walk/ talk to solve problems (c)
	11. Help others with questions
	12. Let others be (let others play)

Greet others

1. Example: Arpro enters the school premises, greets the headmaster and says hi to peers and walks quietly and calmly through the main door following the arrows/ footsteps where to go in.
2. Non-example: Arpro storms into the school premises, does not greet the headmaster or peers, pushes other peers, shouts and yells and storms through the main door.
3. Example repeated two times.

Keep your hands/ feet to yourself

In development. Will be finalised during/ after summer break.

Walk with a goal

1. Example: Arpro walks calmly and safely through the corridor of the school, taking into account the space between them and their peers. Arpro follows the arrows/ footsteps on the floor until they reach their classroom door.
2. Non-example: Arpro runs through the corridor of the school, smashing into their peers. Arpro shouts and yells. Arpro lingers in the corridor.
3. Example repeated two times.

Keep your working space organised
Arpro sits on a chair at a school table with a drawer:

1. Example one: Arpro shows an organised working space and drawer. Arpro indicates to get the materials out for math class and quickly (and only) takes out the math class materials and puts these on the table.
2. Non-example: Arpro shows a messy working space. Arpro indicates to get the materials out for math class and first needs to clean the messy drawer to find the materials. Once the math class materials are found, the table is full of other materials as well.
3. Example two: Arpro shows how to clean up the messy working space and drawer. Afterwards Arpro quickly (and only) takes out the math class materials and puts these on the table.
4. Example one repeated.

Store your belongings
In development. Will be finalised during/ after summer break.

Work independently at your desk
Arpro sits on a chair at a school table:

1. Example: (a) Arpro indicates visually that they are thinking of the steps to take for independent work and text appears "what do I have to do/ know? What does the teacher expect of me?", (b) Arpro indicates visually that they know what to do and text appears "how am I going to do this? What do I do first? What do I do after that? How much time do I need? What is my plan of approach? How much time do I have?", (c) Arpro indicates visually to be in investigative/ working mode (e.g., Arpro takes out their magnifying glass) and text appears "Am I doing well? Or should I start differently? Do I revisit information from the previous lesson? Can/ do I take a short break?", and (d) Arpro indicates visually to evaluate the independent work (e.g., checkmarks appear around Arpro or they take out their green marker to check the process) and text appears "Did I finish my task? Did I use the correct approach? Did I accomplish what I wanted? Can I do it? What can I do better next time?".
2. Non-example: See example, but Arpro skips step b in the process and immediately goes to work (i.e., sequence A-C-D).
3. Example repeated two times.

Stand up for others

1. Example: Three students are standing together on the playground and ostracize another student (victim). The three students are laughing and whispering. Arpro sees this, walks up to the students and indicates that they should not be mean to the victim.
2. Non-example: Three students are standing together on the playground and ostracize another student (victim). The three students are laughing and whispering. Arpro sees this, walks up to the victim and students, says nothing and walks past them.
3. Example: A student posts a video to TicToc. Another student puts a negative comment under the video. Arpro thinks this is not okay and responds to the comment with #benice.
4. Example: A student (perpetrator) walks past a fellow student's (victim) table and pushes off a book on purpose. The victim tells the perpetrator "stop doing that".

The perpetrator kicks the book that fell on the floor. Arpro sees this happening and tells the perpetrator "they told you to stop doing that, so stop doing that" and picks up the book. They subsequently ignore the perpetrator.

Use <u>stop</u>/ walk/ talk to solve problems

1. Example: A student is ticking with their pen, Arpro gives the STOP sign/ asks the student to stop the behaviour.
2. Non-example: A student is ticking with their pen, Arpro shouts out loudly "STOOOOP!".

a. Reflection text appears: what is going wrong and what should have happened?

3. Example: A student is talking with another student in class. Arpro gives the STOP sign/ asks the student to stop the behaviour. The student stops.

. Reflection text appears: what does the student causing the bothersome behaviour have to do in response to the STOP request?

4. Example one repeated.

Use stop/ <u>walk</u>/ talk to solve problems

1. Example: A student is ticking with their pen, Arpro gives the STOP sign/ asks the student to stop the behaviour. The student does not stop their behaviour. Arpro WALKS away and finds a quiet spot to work. The student does not follow Arpro and the behaviour stops.
2. Non-example: A student is ticking with their pen. Arpro shouts out "STOOOOP!" while running away.

a. Reflection text appears: what is going wrong and what should have happened?

3. Example: A student is talking with another student in class. Arpro gives the STOP sign/ asks the student to stop the behaviour. The students keep talking to each other. Arpro walks away and finds a quiet spot to work. The student stops the behaviour.

. Reflection text appears: what does the student causing the bothersome behaviour have to do in response to the WALK request?

4. Example one repeated.

Use stop/ walk/ <u>talk</u> to solve problems

1. Example: A student is ticking with their pen, Arpro gives the STOP sign/ asks the student to stop the behaviour. The student does not stop their behaviour. Arpro walks away and finds a quiet spot to work. The student follows Arpro and does not stop the behaviour. Arpro walks towards the teacher and TALKS about the situation.
2. Non-example: A student is ticking with their pen. Arpro immediately goes to the teacher to talk.

a. Reflection text appears: what is going wrong and what should have happened?

3. Example: A student is talking with another student in class. Arpro gives the STOP sign/ asks the student to stop the behaviour. The students keep talking to each other. Arpro walks away and finds a quiet spot to work. The student does not stop the behaviour. Arpro walks towards the teacher and TALKS about the situation.

. Reflection text appears: what does the student causing the bothersome behaviour have to do in response to the TALK request?

4. Example one repeated.

Help others with questions
In development. Will be finalised during/ after summer break.

Let others be (play)
In development. Will be finalised during/ after summer break.

Annex E

1. Augmented Reality supporting behavioural teaching and learning: State of the art

Introduction

In the last decade, educational researchers and practitioners' interest in emerging technologies, such as Augmented Reality (AR), has increased rapidly and new opportunities to enhance teaching and learning processes have been widely explored. In the educational field, literature has already shown that AR applications used in the learning process can ameliorate students' academic achievement compared to traditional teaching and learning methods (Ozdemir et al., 2018). Existing evidence also provides confirmation that AR educational solutions have a greater impact on learners' experience in terms of content understanding and retention, interest, engagement, and satisfaction with the learning material than traditional and different digital media-related educational experiences do (Garzón et al., 2019; Radu, 2014). Two additional recent reviews described a list of benefits resulting from the use of AR in primary and secondary education (Fotaris et al., 2017; Pellas et al., 2019); specifically, the papers provide relevant indications for the use of AR game-based learning experiences to enhance students' 1) positive attitude towards learning, 2) participation in the educational activities, 3) knowledge transfer, and 4) skill acquisition.

Based on evidence about the positive impact of using AR solutions in the learning process of several educational topics (Fotaris et al., 2017), the ARETE project within WP5 aims at investigating, developing and evaluating the effectiveness of introducing the AR technology for promoting expected positive behaviour at school within the framework provided by SWPBIS. We argue that AR can represent an effective tool to support students' learning of shared values and behavioural expectations, as pillars of the promotion of positive behaviours at school. In other terms, AR can be a promising technology to support behavioural teaching and learning processes integrating it in behavioural activities aimed at teaching positive behavioural routines and alternative responses, reducing the incidence of problem behaviour and supporting the behavioural change.

In this regard, literature has shown that individuals who use different types of AR applications are more open to expected behavioural changes (Connolly et al., 2012). Features of AR can indeed allow for the creation of a potential platform for behaviour change or influence of social activities and routines. However, many studies concentrate on the technological and development features of AR, but limited studies have researched how technology affects social experiences, establishing a positive social culture in school, and in particular the impact of using AR on social behaviour and behaviour changes. Referring to Kim et al. (Kim et al., 2018) review paper, only 9 out of 526 studies explored some aspects of social interaction, which is less than 2%. Moreover, according to recent reviews (Garzón

et al., 2019; Ozdemir et al., 2018), the prevalent use of AR in education concerns the broad field of natural sciences, while only a paucity of studies explored the support provided by AR in social sciences and these focused on the psychology, and health and welfare fields of intervention. To the best of our knowledge, no reviews have specifically addressed the use of AR within interventions designed for behavioural teaching or training. Instruction, practice, feedback, reteaching, and encouragement are strategic elements of an instruction process needed for an effective teaching that go beyond the action of providing the simple rule (Sprague & Golly, 2005; Sugai et al., 2004). It is therefore interesting to explore how AR can be used to enhance the effectiveness of this instructional process.

The purpose of the present scoping literature review was to fill this research gap by investigating the use of AR technology within interventions designed for behavioural teaching and learning, with a specific focus on educational settings. The present review also undertook an exploration of the context of AR technology and its ability to influence social behaviour. Papers were selected and reviewed with the aim of identifying the state of the art of existing AR applications and solutions developed for behavioural teaching and learning, especially with regard to both the:

1) Pedagogical framework informing the interventions; and
2) Implemented AR technology.

Methodology

For the identified research purposes, a scoping literature review was conducted, given that the area of research is new, and investigating the use of AR in social behaviour and interaction has not been studied in detail (Arksey & O'Malley, 2005). Scoping reviews are considered as an excellent instrument to determine the scope of coverage of a range of information on a given subject and provide a clear indication of the amount of available literature as well as an outline of its focus and recommendations for future research/research gaps (Armstrong et al., 2011).

1.1.1. Research questions

In order to identify and better clarify the research questions, we conducted a research strategy based on the PCC (Population, Concept, Context) Framework (Peters et al., 2015). Specifically, this review was primarily interested in the exploration of the use of AR solutions in the context of interventions designed to promote the acquisition of behavioural skills, regardless of the specific target population and intervention setting. An additional review's goal was to look at some of the key aspects of using AR technology and its effect on social behaviour and social interactions. Accordingly, the present work sought to answer the following research questions:

- How is AR used in the context of interventions designed for teaching or training a behaviour?
- What is the impact of using AR on social behaviour?

1.1.2. Scoping review

The first step of the review included the identification of the search strings for the selection of relevant papers. The search strings were edited based on the two main research questions mentioned above. In order to answer the first research question, the strings shown in Table 1 were used for searching papers in three databases: PubMed, Scopus, Web of Science. Papers were additionally searched in the database OpenAIRE using the following search string "augmented reality AND behaviour".

For the second research question, the following string was used:

(("augmented reality") OR (ar) OR ((" smart glasses") OR ("google glass") OR ("smartglasses")) AND (socia*) AND (behav*)

for identifying relevant papers in five electronic databases including PubMed, ACM Digital Library, Web of Science, IEEE Xplore, Scopus.

Papers had to meet the following inclusion criteria in order to be included in the review:

- papers from any country (written in English);
- papers published since 2010;
- full text available;
- given the paucity of experimental or quasi-experimental studies on the review topics, general discussion and theoretical papers, case studies, examples of applications, reports, and conference proceedings were included;
- peer-reviewed papers.

More specifically, for the selection of papers related to the first research question, two further exclusion criteria were followed:

1) papers exploring only the acceptance of technology and user behaviour when dealing with technology were excluded, and
2) clinical studies not concerning the training of social behaviour were excluded.

Table 1.
Strings Used for the First Research Question

Search String	Search Engine
TITLE-ABS-KEY (("augmented reality" OR AR OR XR) AND behavio* AND (education* OR train* OR teach))	Scopus
(((""augmented realit*"" [TIAB] OR ""mixed realit*"" [TIAB]) AND (behav* [TIAB])) AND (educat* [TIAB] train* [TIAB] OR learn* [TIAB] OR teach* [TIAB] OR modif* [TIAB]) "	PubMed
"(ALL = ("augmented reality" AND (behavio* OR PBIS) AND (education* OR train*))) AND DOCUMENT TYPES: (Article OR Book OR Book Chapter)	WoS
TITLE-ABS-KEY (("mixed reality" OR "augmented reality") AND ("path finding" OR "slam" OR "Object detection" OR "Artificial intelligence" OR "scene perception") AND "behav*")	Scopus
(TS = (("mixed reality" OR "augmented reality") AND ("path finding" OR "slam" OR "Object detection" OR "Artificial intelligence" OR "scene perception") AND "behav*"))	WoS
augmented reality AND behavior	OpenAire

For the selection of papers for the second research question, papers were excluded if they claimed to refer to AR but actually referred to mixed reality or virtual reality. A preliminary screening of title and abstract of papers has been applied in order to remove those not relevant to the research questions. After this first screening, papers underwent a further screening based on the inclusion and exclusion criteria. Overall, we followed the PRISMA protocol (Liberati et al., 2009) for the selection of the articles as adapted to the purposes of the scoping review (Tricco et al., 2018). Figure 1 shows the PRISMA protocol for the selection of papers relevant to the first research question of this scoping review. Figure 2 summarises the steps followed for the papers identified and selected for the second research question. As shown in both figures, a total of 77 articles were selected to be included in the current work (n=41and n=36 for the first and the second research question respectively). Seven articles selected for the second research question were found to be overlapping with those identified and chosen to answer the first research question. As a consequence, a total of 70 papers were reviewed and charted for the purposes of the current work.

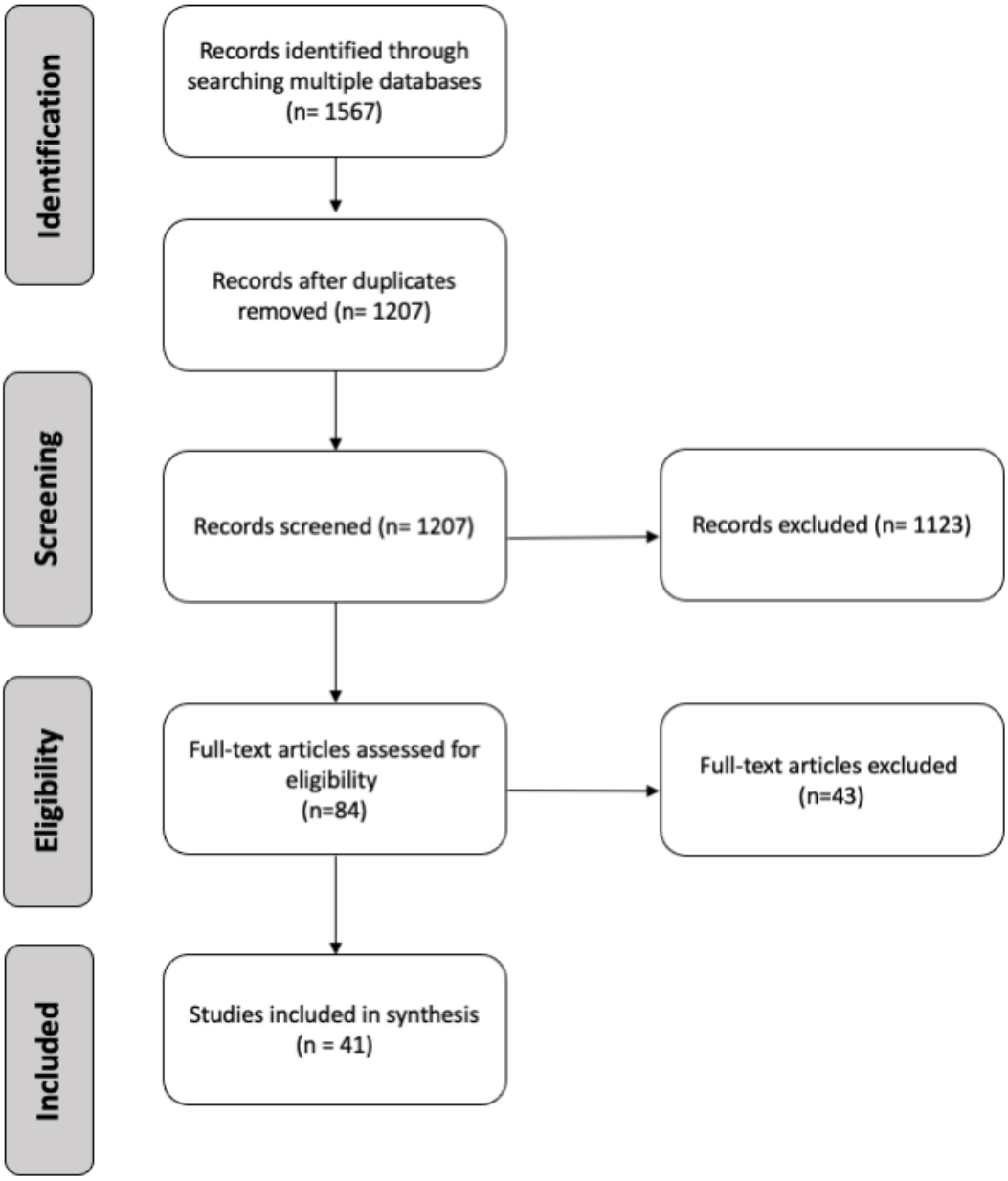


Figure 1 PRISMA Protocol for Articles Relevant to the First Research Question

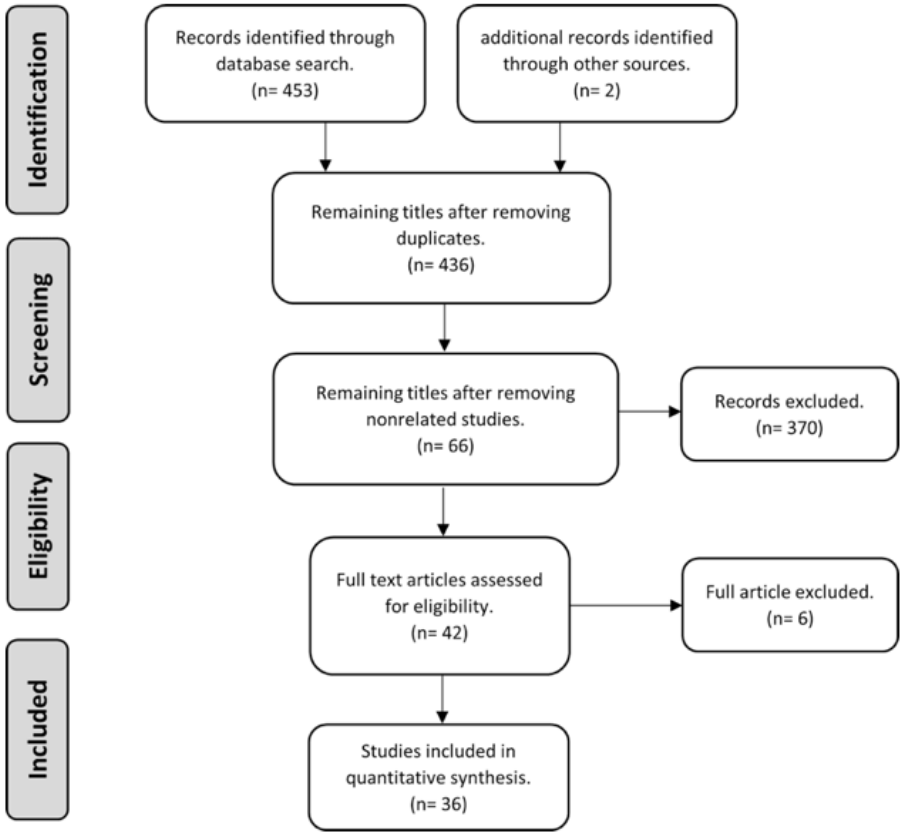


Figure 2 PRISMA protocol for articles relevant to the second research question

1.1.3. Data charting

Once the study selection was completed, salient information was extracted from the papers selected to answer the first research question with respect to the following dimensions:

- Year of publication
- Type of publication
- Keywords
- Setting (academic, clinical, professional)
- Target population:
    - for academic settings: age and grade
    - for clinical settings: age and disease
- Type of AR technology
- Purpose of AR application
- Theoretical framework of the behavioural intervention
- Key findings

Also, to address the second research question, the features and information of the selected papers have been extracted into a table to provide a detailed overview of the documents included. The following is a list of critical information to chart for each paper:

- Title of publication
- Year of publication
- Study purpose
- Participants (age group and number of participants)
- Technology used (Software/Hardware)
- Assessment method
- Key findings

Results and Discussion

The following two sections aim at summarising the results of the current work on the basis of the two questions that guided the research. Specifically, the first section provides an overview of the studies related to the first research question; the second section describes in summary the results of the review of the papers selected for the second research question.

1.1.4. The use of AR within interventions designed for teaching or training behaviours

First of all, we present the distribution of papers related to the use of AR within interventions designed to promote the acquisition of behavioural skills as they have been differentiated per setting of intervention (see Table 2). We basically identified three main settings within which each intervention supported by the use of AR technology was designed or implemented: educational, clinical, and professional; on the other hand, we used the broad and unspecific label "Other" to include types and settings of intervention that cannot be categorised under the main labels.

Table 2.
Number of articles selected per setting of intervention

Setting	N	References
Educational	18	Alonso-Silverio et al., 2018; Bouaziz et al., 2020; Carreon et al., 2020; Cihak et al., 2016; Hadi et al., 2019; Gweon et al., 2018; Holley & Howlett, 2016; Huang & Lee, 2020; Juan et al., 2011; Lai & Chu, 2017; Lee, 2020; Lorusso et al., 2018; Mylonas et al., 2019; Osadchyi et al., 2020; Pas et al., 2016 Sahin, Abdus-Sabur, et al., 2018; Santos et al., 2012; Wang & Lee, 2020
Clinical	12	Alqithami et al., 2019; Banneyer et al., 2018; Begoli et al., 2017; Ben-Moussa et al., 2017; Bridges et al., 2020; Chen et al., 2016; Hsu & Lee, 2020; McGuirt et al., 2020; Radovic & Badawy, 2020); Tentori et al., 2015; Vahabzadeh, Keshav, Salisbury, et al., 2018; Vigil-Hayes et al., 2019
Professional	4	Clark et al., 2019; Dixit & Sinha, 2019; Gardelis et al., 2018; Lampen et al., 2020
Other	7	Almurashi & Bouaziz, 2020; Hanafi et al., 2020; Lakshmiprabha et al., 2014; Miller et al., 2019; Roth et al., 2019; Shirai et al., 2020; Watson et al., 2018

Note. N=number of selected articles.

Most of the papers describe studies related with the impact of AR technology to social behaviour conducted in the educational setting, followed by articles presenting AR solutions designed for clinical settings. It is noteworthy that many studies, even if conducted in the school context, focused on subjects with specific behavioural difficulties, and mainly with Autistic Spectrum Disorder (ASD). Finally, the scientific production investigating the impact of AR technology on behaviour training and management in work environments is marginal and limited to the last few years.

Figure 3 shows the evolution over time of the number of papers differentiated per setting of intervention (Fig. 3).

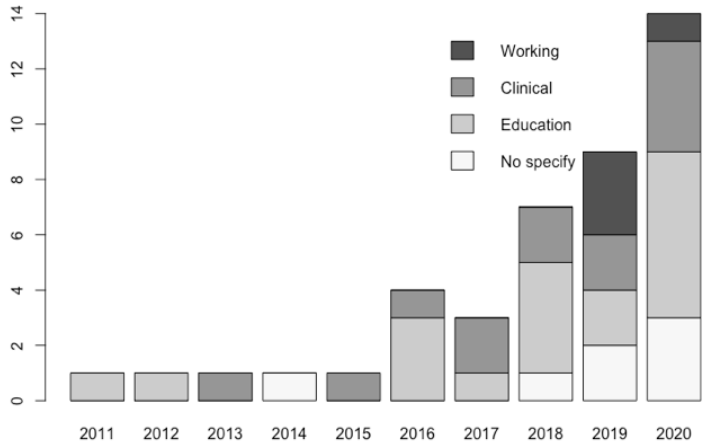


Figure 3 Number of Papers per Year and Setting of Intervention.

Looking at the trend of the selected publications, a marked increase in the number of published papers from 2016 can be observed; the year 2020 specifically shows a relevant number of published papers in both the educational and clinical settings.

Table 3.
Number of selected studies per school grade

School Grade	N	References
Early	2	Gweon et al., 2018; Lorusso et al., 2018
Primary	8	Cihak et al., 2016; Mylonas et al., 2019 Holley & Howlett, 2016; Huang & Lee, 2020; Juan et al., 2011; Lee, 2020; Pas et al., 2016; Wang & Lee, 2020)()
Low secondary	6	Carreon et al., 2020; Juan et al., 2011; Mylonas et al., 2019; Pas et al., 2016; Sahin, Abdus-Sabur, et al., 2018; Santos et al., 2012
Upper secondary	2	Mylonas et al., 2019; Pas et al., 2016
Tertiary	4	Alonso-Silverio et al., 2018; Hadi et al., 2019; Lai & Chu, 2017; Osadchyi et al., 2020
Not specified	1	Bouaziz et al., 2020

Note. N=number of selected studies. Some articles cover multiple studies at different school grades.

The distribution of the studies conducted in an educational setting and differentiated per school grade is summarised in Table 3. Studies involving primary school students prevail, together with those targeting secondary school students, 10 and 6 respectively out of a total of 25 analysed papers (note that some articles cover multiple studies, at different school grades). According to these studies, AR technology was mainly used to support the learning process of basic social and relational skills, with a significant number of applications for students diagnosed with ASD (Cihak et al., 2016; Huang & Lee, 2020; Pas et al., 2016; Sahin, Abdus-Sabur, et al., 2018; Wang & Lee, 2020).

With regard to the most used devices for the fruition of AR content in the school and academic settings, smartphones and tablets prevailed (11 papers out of the 18 selected), and only in rare cases PC and webcams were still used (Alonso-Silverio et al., 2018; Huang & Lee, 2020). Few works introduced wearable devices such as smart glasses (Sahin, Abdus-Sabur, et al., 2018) and helmets (Osadchyi et al., 2020) or more advanced technologies such as the kinect skeletal tracking system (Lee, 2020). This is probably due to the fact that the introduction of

advanced devices and technologies is not always feasible in the educational field, which is characterised by a large number of stakeholders, as well as a lack of financial resources and specific expertise, both of which are necessary to handle innovative technologies.

AR solutions were mainly used as tools to support learning and training of prosocial (Holley & Howlett, 2016; Huang & Lee, 2020; Lorusso et al., 2018; Wang & Lee, 2020) and anti-corruption (Hadi et al., 2019) behaviours, for environmental education (Mylonas et al., 2019; Santos et al., 2012), and for the training of specific motor skills (Alonso-Silverio et al., 2018). Looking in more detail, Table 4 shows in detail the distribution of the papers per behavioural skill. In particular, papers were divided according to target users: 17 addressed for teachers and 2 for students, in order to detect how the support of AR in behavioural teaching and learning processes respectively.

Table 4.
AR usage in teaching and learning behavioural skills

Target users	Behavioural skills	N	References
S	Social and communication skills	7	Huang & Lee, 2020; Lai & Chu, 2017; Lee, 2020; Lorusso et al., 2018; Mocholí et al., 2006; Sahin, Abdus-Sabur, et al., 2018; Wang & Lee, 2020
S	Self-regulatory skills	2	Gweon et al., 2018; Osadchyi et al., 2020
S	Psychomotor skills	1	Alonso-Silverio et al., 2018
S	Environmental behaviour skills	3	Juan et al., 2011; Mylonas et al., 2019; Santos et al., 2012
S	Daily life skills	2	Bouaziz et al., 2020;Cihak et al., 2016
S	Anti-corruption behaviours	1	Hadi et al., 2019
T	Classroom management skills	3	Carreon et al., 2020; Holley & Howlett, 2016;Pas et al., 2016

Note. N=number of selected articles. S= students. T=teachers.

Studies targeting teachers use AR both to enrich their learning experience and to create augmented contents for students. In particular, the studies (Holley & Howlett, 2016; Pas et al., 2016) use AR to support the training of teachers' classroom management skills. The paper (Carreon et al., 2020) proposes the use of an authoring tool to create AR teaching contents and support the learning of classroom behavioural routines (how to open a locker, walking down the hall,

turning in one direction, etc.). In this case the marker-based solution was used to trigger small video clips of 'critical incidents' on low-level disruption in classrooms to increase the teacher's awareness and management skills. Quite a few works directly addressed teachers' perspective on the acceptability of AR solutions through the use of specific questionnaires or reported on their experiences in somewhat anecdotal terms. Overall, teachers perceived the AR-based intervention as an interesting, easy to use, and generally acceptable way to learn or teach new skills (Cihak et al., 2016; Holley & Howlett, 2016); however, they highlighted the need for additional time and specific training to become familiar enough with the use of a more complex technological solution (Pas et al., 2016).

Several papers presented the use of AR to promote social and communication skills. The work by Lorusso et al. (2018) uses a game-based learning scenario where the child is invited to face and solve different social situations proposed by the game. The children are involved in the exercise of nonverbal communication skills, social and pragmatic skills following the coaching of funny and emotionally expressive characters that invite them to solve simple and concrete daily-life situations, inciting them to reflect and apply the appropriate social rules. AR is applied in the game to obtain information from a tangible object (a physical cube) to trigger events such as an answer to a question and proceed with the game. The paper by Mocholí et al. (2006) proposes AR game simulation able to adapt and respond to the child's stimuli. Children engaged in activities such as feeding animals with different types of food have to assess different states of health based on the emotional states manifested by the animals and according to the actions taken by them.

Social reciprocity, wisdom, courage, self-confidence are skills trained in a system that combine the stage acting with the use of scene props and AR cards in a role-play game to get ASD children to reflect on the corresponding relationship between the animation and the abstract concepts and the symbols represented in the flashcards (Wang & Lee, 2020). AR physical cards are also used in combination with concept maps boards in an AR social-training system for training ASD children in social situations and social relationships (Huang & Lee, 2020). Lai and Chu show how the presence of virtual agent and characters influence the social interaction of people in an augmented reality scenario (Lai & Chu, 2017). This aspect suggests their application in the learning of social communication skills such as interactive social skills of body language and facial expressions (Lee, 2020), gaze behaviour visuomotor skills (Sahin, Abdus-Sabur, et al., 2018).

The use of AR for supporting the self-regulatory skills are presented in the papers by Gweon et al., (2018) and Osadchyi et al., (2020). A puppet with an AR marker helped parents to show their child the mood of a puppet friend with different facial expressions according to the media usage behaviour of the child (Gweon et al., 2018). A mixed reality solution is used to train the self-regulation of stress levels of psychotherapists in a series of stress resistance tasks (Osadchyi et al., 2020).

Other articles show the application of AR to promote pro-environmental behavioural skills with AR game marker based systems (Alonso-Silverio et al., 2018; Juan et al., 2011; Mylonas et al., 2019).
Daily life skills such as brushing teeth (Cihak et al., 2016) and learning steps of eating daily life skills (Bouaziz et al., 2020) are daily routines trained with the use of AR for support chain tasks. AR marker-based solution and flashcards are used to show to ASD children the different steps to apply in a chain task such as brushing teeth or eating with cutlery.

The last two studies regarding training in the higher education field. The first, aims to train psychomotor skills of medical students (Alonso-Silverio et al., 2018). In particular, surgical psychomotor skills of medical students are trained in mixed reality solutions with the use of a mannequin, an HD Webcam, a Monitor TV and surgery equipment. AR is used for showing in the monitor the ideal path of the spiral cut to follow and practice in a part of manikin during a cutting task. The second, indeed, is focused on the use of AR to promote anti-corruption behaviours in university students through the use of AR in visual novels (Hadi et al., 2019).

With regard to the theoretical framework, some of these papers were based on traditional approaches to the treatment of behaviour such as behavioural change (Lee, 2020; Mylonas et al., 2019; Sahin, Abdus-Sabur, et al., 2018; Santos et al., 2012), social modelling (Huang & Lee, 2020; Wang & Lee, 2020), and cognitive-behavioural (Osadchyi et al., 2020) approaches. Other papers addressed behavioural training from the perspective of concept mapping (Huang & Lee, 2020), visual novel (Hadi et al., 2019), theatre-based training (Wang & Lee, 2020), and coaching (Pas et al., 2016), or were inspired by more general theories, such as neuroconstructivism (Lorusso et al., 2018), the persuasion theory (Santos et al., 2012), and the theory of reasoned action (Juan et al., 2011). We can say that AR has been used within a plurality of methodological frameworks. This clearly demonstrates the flexibility of this technology, but also points to an evolving landscape in which strengths and weaknesses, opportunities and challenges related to its application in the educational setting are not always fully defined.

Coming to papers reporting on interventions delivered within a clinical setting, ASD were the most commonly treated or discussed disorders (Begoli et al., 2017; Chen et al., 2016; Hsu & Lee, 2020; Tentori et al., 2015; Vahabzadeh, Keshav, Salisbury, et al., 2018), followed by anxiety disorders (e.g social anxiety disorder or generalized anxiety disorder) (Banneyer et al., 2018; Ben-Moussa et al., 2017), and attention-deficit hyperactivity disorder (Alqithami et al., 2019; Vahabzadeh, Keshav, Salisbury, et al., 2018). Additionally, a paper included in this category described a socio-emotional learning intervention aimed at promoting the development of emotional coping and interpersonal skills among adolescents in a community setting (Vigil-Hayes et al., 2019). It should not be surprising, given the nature of the disorders considered, that the papers mostly reported findings

about AR solutions embedded into interventions designed for children (Banneyer et al., 2018; Begoli et al., 2017; Ben-Moussa et al., 2017; Chen et al., 2016; Hsu & Lee, 2020; McGuirt et al., 2020; Tentori et al., 2015; Vahabzadeh, Keshav, Salisbury, et al., 2018), while young adults (Vahabzadeh, Keshav, Salisbury, et al., 2018) and adults (Bridges et al., 2020) were shown to be underrepresented.

When treating patients with ASD and ADHD, AR was used to enhance interventions designed to train behavioural and social skills, manage problem behaviours, and promote positive behaviours (Chen et al., 2016; Hsu & Lee, 2020; Tentori et al., 2015; Vahabzadeh, Keshav, Salisbury, et al., 2018). With regard to anxiety disorders, AR solutions were mainly implemented for the treatment of phobias and social anxiety through exposure practice (Banneyer et al., 2018; Ben-Moussa et al., 2017). The examined AR interventions mostly followed a cognitive-behavioural approach (Alqithami et al., 2019; Banneyer et al., 2018; Ben-Moussa et al., 2017), and used video-modelling strategy within the social learning framework (Bridges et al., 2020; Chen et al., 2016). Cognitive training (Vahabzadeh, Keshav, Salisbury, et al., 2018) and sequence learning framework (McGuirt et al., 2020) were also reported as theoretical and methodological frameworks underpinning the implemented interventions. Finally, AR solutions were developed for use with both portable (smartphone and tablet) and wearable devices (hololens and smart glasses) (Alqithami et al., 2019; Begoli et al., 2017; McGuirt et al., 2020). Overall, we can summarise these results stating that the application of AR technology in the clinical field mainly addressed neurodevelopmental disorders, such as ASD and ADHD, and anxiety disorders in childhood.

Regarding the implementation of AR solutions for professional training (see Table 1), it is noticeable that the selected papers were all published between 2018 and 2020; thus, it seems that the use of AR technology for behavioural training is a relatively new research topic in this area. Applications ranged from medical (Dixit & Sinha, 2019) to foodservice (Clark et al., 2019), green driving (Gardelis et al., 2018), and industrial assembly (Lampen et al., 2020) fields. In this context, the use of innovative technological systems and devices was more frequent, as in the case of complex gaming systems that used head-up devices (HUDs) (Gardelis et al., 2018) or equipped with sensors and kinetic simulators (Lampen et al., 2020). The use of smart glasses (Clark et al., 2019) and head-mounted devices (HMDs) (Lampen et al., 2020) was also frequent.
From a theoretical point of view, an approach that focuses on procedural training through segmentation into micro-tasks, as described in Lampen et al. (Lampen et al., 2020) was common. On the other hand, a more general theoretical framework was presented in the work of Clark et al. (Clark et al., 2019), where reference was made to embodied cognition, or grounded cognition, and in the work of Dixit and Sinha (Dixit & Sinha, 2019). In these papers, authors were interested in investigating the effectiveness of AR as a tool to facilitate the transfer of skills taught in specific behavioural training programmes.

In summary, AR technologies were used in this context to simulate complex environments and define well-structured training programmes with measurable performances, such as the assembly of car doors (Lampen et al., 2020), handwashing procedures in a foodservice (Clark et al., 2019), or the driving performance in terms of fuel consumption and pollution (Gardelis et al., 2018). This contrasts with research conducted in the educational field where AR solutions were typically designed to support learning by fostering students' attention and motivation.

1.1.5. The impact of AR on social behaviour

Although public interest in AR is new and increasing, academic researchers have been developing and researching the impact of technology on human social behaviour for decades. Miller et al. (Miller et al., 2019) studied social interaction in AR, by designing three different experiments to examine the socio-psychological effects of AR. A well-known psychological hypothesis (i.e. social facilitation/inhibition) was introduced to an AR user with a virtual agent in the first experiment. The second experiment investigated whether users respond to social norms, while dealing with virtual persons, as well as whether spatial connections between physical locations and virtual information affected subsequent behaviour. Lastly, the third experiment looked at the social costs of wearing an AR headset in comparison to people that are not wearing one. Participants interacted in dyads, and those who used AR headsets showed less emotional attachment to their partner than those who did not use AR headsets. To summarize their findings, the presence or absence of virtual content was shown to have a significant impact on task performance, nonverbal behaviour, and social connectedness. Similarly, children's behaviour can be significantly influenced by visual input provided by AR technology (Shirai et al., 2020). In this study, before completing a filler task, two children aged 5-10 years old were shown a human-like AR character standing on one of the two physical routes. Following the task, the kids were asked to walk along one of two routes in order to receive a reward. Both children preferred the non-AR character pathway to the AR character pathway.

AR technology can also help young children's empathic behaviour as it stimulates children's imagination and creativity without causing them to lose touch with reality. Empathy is one of the most important factors in a child's ability to make friends at school and expand their social relationships. Gil (Gil et al., 2014) developed an AR storybook based on role-plays that allows children to learn empathy skills through an interactive reading environment in which they think and communicate in the voice of the story's characters.

Digital games with AR features have quickly become one of the most common types of entertainment in the world (Holt-Lunstad et al., 2015). People who play digital games are more open to future improvements in their behaviour. AR technologies such as AR games can improve users' social interaction and behaviour. Researchers observed a famous AR game, Pokémon Go, and

discovered that AR games can have beneficial behavioural effects, including social interaction (Serino et al., 2016). The entertainment interest of AR games is an important aspect, and it becomes much more important when investigating AR game outcomes in the scope of leisure time. Gamification, in general, has incorporated studies on technology and game design, inspiration, and human–computer interaction, among other things (Savela et al., 2020). Arjoranta (Arjoranta et al., 2020) highlighted another research on the different forms of behaviour changes and their underlying game characteristics in the form of the popular AR game Pokémon GO. The study data was gathered using a survey of 262 Pokémon GO participants, and the results show that the questioned players adjusted their behaviours before or after playing Pokémon GO. The participants said they were more social, expressed more positive feelings, found more value in their daily lives, and were more motivated to discover their environments.

Learners' behavioural intentions can be influenced by their perceptions of the AR-learning system's efficacy and satisfaction. Chang's study (Chang et al., 2011) demonstrated how satisfied learners are with the AR-learning system, as well as their behavioural intentions to use the system and how effective it is. According to the work done by Kim (Kim et al., 2017), AR has the potential to overcome the lack of ability of Intelligent Virtual Agents to provide non-verbal cues which are an important part of social interaction. This study's findings suggest that augmenting an agent with a visual body in AR and normal social behaviours could enhance the user's confidence in the agent's ability to affect the real world. Although many AR apps show embodied agents in scenes, no research into the social impact of these AR renderings has been undertaken. Jun (Jun & Bailenson, 2020) attempted to fill this research gap by investigating the social impact of simulated humans through two lenses: behavioural and anthropomorphic realism.

Children with special needs, especially those with Autism Spectrum Disorders (ASD) (Lord & Jones, 2012), social communication disorders (Norbury, 2014), and attention-deficit/hyperactivity disorder (ADHD) (Mansour et al., 2017) struggle to use appropriate communication techniques and skills in social interactions with their peers. We present here some articles describing the use of AR for clinical purposes in children diagnosed with ASD and ADHD. Some of these articles have already been summarised in the previous section (see section 3.3.1) and are discussed here in more detail; moreover, the research conducted to answer the second question of this review made it possible to identify new papers than those already found, some of which are introduced here as being of particular interest. Based on Vahabzadeh (Vahabzadeh, Keshav, Abdus-Sabur, et al., 2018) work, such individuals can benefit from assistive AR smart glasses technology. Their findings show that AR smart glasses can help students with ASD improve their feelings of anxiety, hyperactivity, and social withdrawal in a public elementary school environment. Furthermore, AR smart glasses could be an important tool for meeting the behavioural needs of children diagnosed with ASD (Sahin, Keshav, et al., 2018). The Liu et al. study (2017) shows that a specialized AR smart glass solution is practical, functional, and acceptable. Children diagnosed with ADHD, in comparison to their non-ADHD peers, have poor school and academic

performance. By using AR smart glasses preliminary support and their ability, it can minimize ADHD-related symptoms in school-aged girls, teenagers, and young adults with ASD, such as hyperactivity, inattention, and impulsivity (Vahabzadeh, Keshav, Salisbury, et al., 2018). One of the activities that has been proved to be especially beneficial in the treatment of children with social communication disorders is storytelling. Storytelling is crucial for the linguistic and cognitive growth of infants. The Chen AR model could be helpful in educating children on how to recognize and understand the emotions expressed in facial expressions in daily social interactions with children of all ages (Chen et al., 2016). They can learn about body language and facial expressions through roleplay. This teaching method can effectively improve the interactive social skills of children diagnosed with ASD and reduce the fear and anxiety which they typically experience when they face real people. Roleplaying will teach them about body language and facial expressions. This teaching approach will help children with specific needs to develop their interactive communication skills while also reducing their fear and anxiety when they interact with regular humans (Lee, 2020).

State of the Art and Pilot 3 Advancement

In Table 2 we presented an overview of the papers describing AR-mediated interventions designed for behavioural teaching and learning. Most of the reviewed papers reported on interventions conducted in an educational setting that were designed to have an impact on relevant social behavioural skills; moreover, a smaller but significant number of articles presented AR solutions intended for behavioural training within clinical settings. It should also be noted that many interventions, in both the educational and clinical settings, concerned specific behavioural difficulties, especially related to the Autistic Spectrum Disorders (ASD).

To the best of our knowledge, no research has investigated the impact of AR solutions for the promotion of students' expected behaviour at a school-wide level and mainly from a preventative perspective. To address this gap in the literature, Pilot 3 introduces an AR solution for the use within the theoretical framework provided by SWPBIS. Specifically, within Pilot 3, the AR solution represents an aid to be used during behavioural lessons designed to teach students a set of behavioural expectations and support their practicing of learned behaviours. Interestingly, one of the reviewed papers (Lorusso et al., 2018) described an AR app developed for kindergarten children with the aim of stimulating the acquisition of problem-solving skills focusing on, among others, skills and abilities, social skills and theory of mind. However, the AR solution for Pilot 3 introduces a novelty as far as the acquisition of social skills is promoted as part of a school-wide program of interventions aimed at fostering children's behavioural and cognitive growth.

A paper selected for the scoping review (Pas et al., 2016) reported preliminary positive findings about the effectiveness of a mixed-reality supported training and coaching intervention for teachers working with children with ASD. Specifically, the intervention described in the study targeted teachers' classroom management

skills within the framework of Classroom Check-Up (CCU); CCU involves the use of positive behavioural supports such as the definition of behaviour expectations, use of reinforcement, and greater opportunities to practice the learned behaviour. This methodological framework overlaps to some extent with that informing the Pilot 3 educational intervention but the technological solution was exclusively embedded in a training and coaching programme targeting teachers' skills. Moreover, the programme only addressed teachers' skills in managing behavioural issues of children diagnosed with ASD. In this regard, the AR-PBIS solution goes beyond since it is intended for the use with and by students and also introduces an advancement by exploiting the potential of AR in mainstream primary education.

Another paper (Holley & Howlett, 2016) described the activities of a project interested in realizing a highly contextualised behavioural management training for teachers, supported by a basic AR solution. The paper interestingly emphasises the need to involve students in the design process of the training material, an aspect neglected in the existing literature. In this regard, Pilot 3 tries to respond to this relevant recommendation. First, students from participating schools have been actively involved in the selection of relevant behavioural expectations to be addressed by the Pilot 3 intervention in their classroom and other school environments; their inclusion in the selection process ensures that the educational intervention is perceived as meaningful thus increasing as much as possible its ecological validity. Second, students are also planned to be involved in the activities of the Lesson Study so that their voice is allowed to inform the design of the AR-supported educational material.

As noted above, most of the papers discussing interventions conducted in clinical settings focused on the treatment of children diagnosed with ASD and ADHD. In this case, AR solutions were mainly used to support interventions aimed at training behavioural and social skills, managing problem behaviours, and promoting positive behaviours. A paper (Tentori et al., 2015) described an AR solution consisting of an ambient display supporting a gamified experience for autistic children. Purpose of the AR gamification was to reflect children's behaviour and raise their awareness of current behavioural patterns to promote a shift towards positive behaviour. In this regard, the Pilot 3 moves forward in designing an AR solution that will be used to both directly teach/show and actively practice an expected behaviour. In doing so, Pilot 3 follows the theoretical assumption according to which behavioural lessons that include components of direct instruction consisting of showing/teaching and practicing will be most effective. Specifically, students' reflection on their typical behaviour is intended to be stimulated during the practice phase of Pilot 3 behavioural lessons.

Another study (Chen et al., 2016) developed a technology-based solution combining AR and video-modelling to train ASD children social skills (i.e. better understanding of facial expressions and emotions); specifically, the AR solution consisted of a series of short videos overlaid on a storybook images. Compared to a marker-based solution that augments the images of a storybook with pre-defined AR videos, the AR-PBIS solution wants to overcome the marker-based

solutions with a marker-less solution allowing the positioning of AR animation contents on the basis of environment recognition. In this way, the AR-PBIS solution wants to leverage behavioural modelling based on animations of a 3D character in a real environment. Indeed, children tend to have and develop a greater sensitivity and empathy towards insubstantial agents and imaginary friends, and this suggests the use of 3D characters that are not visible in the reality but visible in the augmented reality to stimulate students' motivation to learn. This evidence supports the adoption of animation by making interaction and behavioural modelling more attractive to the learner than video. The training scenario then becomes the real environment in which the user can see a 3D character that as a coach shows how to perform a positive behaviour directly on the real setting where the behaviour is expected. Also, it is worth noting that in the cited study AR was embedded in the paper-based training tool to attract children's attention and give emphasis to the most relevant details of the learning content. Different AR solutions developed to improve social situation understanding (Hsu & Lee, 2020) and manage Attention-Deficit/Hyperactivity Disorder symptoms in autistic individuals (Vahabzadeh, Keshav, Salisbury, et al., 2018) also leveraged the ability of augmented reality to focus users' attention on relevant stimuli. Differently, the learning contents of AR-PBIS solution becomes the expected behaviour in the different school settings (entrance, hallway, restroom, classroom etc.). Thus, the real environment becomes the setting in which the behaviour is to be manifested considering the constraints and elements contained therein and with which the learner may take account to perform the behaviour.

Finally, it should be noted that many of the discussed studies showed solutions that integrate augmented reality learning resources into applications [e.g. Chen et al., 2016; Hsu & Lee, 2020) making the system prevalently static and preventing the integration of new learning resources unless a new software version is released. In a more dynamic and less static perspective, within pilot 3 a solution will be conceived in an OER perspective that supports the dynamic creation and use of learning resources through the ARETE repository of augmented reality learning resources. In this perspective the AR software solution for PBIS wants to be more versatile by offering an active role to the teacher in the production of their own behavioural educational resources in AR in a dynamic and not static way, saving them and making them reusable in their own school context of interest.

Relevant Findings and Pilot 3 Advancements

We report here some relevant findings and recommendations drawn from literature analyzing both 1) the use of AR technology in the educational field, and 2) its role in enhancing interventions designed for the promotion of behavioural skills:

- The use of AR can influence students to learn actively and can motivate them, leading to an effective process of learning.
- AR has been shown to have good potential in making the learning process more active, effective and meaningful. This is because its advanced technology enables users to interact with virtual and real time contexts and brings the natural experiences to the user.
- Many studies show that students can improve their mastery of abstract concepts and address the problem of misconception, helping students better understand.
- In addition, the merging of AR with education has recently attracted research attention because of its ability to allow students to be immersed in realistic experiences.
- AR experiences should complement rather than replace traditional behavioural lessons.
- AR enhances social skills learning since it represents a bridge between real-world activities and digital experience thus stimulating children's decision making and social problem solving in different social scenarios.
- AR technology can help young children empathic behaviour as it stimulates children's imagination and creativity without causing them to lose touch with reality.
- People who play digital games are more open to future improvements in their behaviour.
- The use of the AR can impact on all relevant processes characterising social/observational learning:

    - Attentional: improving semantic and judgmental acts
    - Retention: helping to encode information in a framework
    - Motoric reproduction: enforcing the motor reproduction competences
    - Motivation and incentives: linking incentive and informative functions of reward.

Below, we add a shortlist of the advancements to the state of the art of AR use in behavioural teaching and learning that could guide the development of the AR solution for Pilot 3:

- Studies suggest promising findings about the effectiveness of augmented reality-based treatments for the promotion and support of social skills in children and adolescents with special needs.
- No research has yet investigated the impact of AR solutions for the promotion of students' outcomes at a school-wide level and mainly from a prevention perspective. In this regard, the Pilot 3 AR solution introduces a novelty as far as it is specifically designed for SW-PBIS, a school-wide and preventive approach promoting students' positive behaviour and scholastic

outcomes and grounded on a strong and well-validated theoretical framework.

- Following previous research on positive behaviour supports for students with special needs (e.g. Pas et al., 2016), the ARETE Pilot 3 extends to students the use of AR for training purposes and rigorously validates the use of AR technology in the context of mainstream education.
- Following recommendations from existing research (Holley & Howlett, 2016), the Pilot 3 actively involves students' perspective in the selection of relevant behavioural issues and the design of educational material.
- Pilot 3 AR solution advances previous work (Tentori et al., 2015) as far as provides an AR solution that can be used for both teaching and practicing expected behaviour.
- Following previous research (Bridges et al., 2020; Chen et al., 2016), the AR-PBIS solution relies on a combination of AR and video-modelling strategy to teach behavioural skills. The assumption is that AR can attract students' attention and highlight relevant content during the training of the expected behaviours (Chen et al., 2016; Hsu & Lee, 2020)
- Moreover, the AR-PBIS solution represents an advancements since it overcomes the marker-based solutions with a marker-less solution that allows the positioning of AR contents on the basis of environment recognition.
- Differently from existing AR solutions e.g. (Chen et al., 2016; Hsu & Lee, 2020), the AR software solution for PBIS is designed to allow teachers to produce their own behavioural educational resources in AR in a dynamic way making them usable in their own school context of interest.
- Based on existing research (e.g. Hsu & Lee, 2020; Shirai et al., 2020, the use of AR 3D characters and animations can be useful for modeling positive behavioural routines.

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Annex F

ARETE Pilot 3 CONSORT 2010 Flow Diagram[1,2,3]

ARETE

CONSORT

TRANSPARENT REPORTING of TRIALS

Approach

Approached (n = xx PBIS schools; across Netherlands and Italy)

Excluded (n = xx schools)
- Reasons (list reasons with number of schools)

Screened/assessed for eligibility (n = xx PBIS schools)

Excluded (n = xx PBIS schools)
- Reasons (list reasons with number of schools)

Enrollment

Assigned to Interventions (n = xx PBIS schools, n = 30-39 classrooms, median per school = xx, n = ± 750 students;

Allocation/Random Assignment

AR-PBIS condition (2022)
(n = xx schools; n = 10-13 classrooms)
Recruited students (n = ± 250 students, average classrooms size and variance)
Recruited Parents/Guardian (n = ± 250)
Recruited Teachers (n = ± 10-13)

PBIS condition 2021
(n = xx schools; n = 10-13 classrooms)
Recruited students (n = ± 250 students, average classrooms size and variance)
Recruited Parents/Guardian (n = ± 250)
Recruited Teachers (n = ± 10-13)

PBIS condition 2022
(n = xx schools; n = 10-13 classrooms)
Recruited students (n = ± 250 students, average classrooms size and variance)
Recruited Parents/Guardian (n = ± 250)
Recruited Teachers (n = ± 10-13)

Follow-Up*

Lost to follow-up
(n = xx schools, n = xx classrooms)
Reasons (list reasons with number of schools and classrooms)
Student who did not complete follow-up (n = xx)
Students who discontinued intervention (give reasons) (n = xx)
Parents who did not complete follow up (n = xx)
Teachers who did not complete follow up (n = xx)
Teachers who discontinued intervention (n = xx)

Lost to follow-up
(n = xx schools, n = xx classrooms)
Reasons (list reasons with number of schools and classrooms)
Student who did not complete follow-up (n = xx)
Students who discontinued intervention (give reasons) (n = xx)
Parents who did not complete follow up (n = xx)
Teachers who did not complete follow up (n = xx)
Teachers who discontinued intervention (n = xx)

Lost to follow-up
(n = xx schools, n = xx classrooms)
Reasons (list reasons with number of schools and classrooms)
Student who did not complete follow-up (n = xx)
Students who discontinued intervention (give reasons) (n = xx)
Parents who did not complete follow up (n = xx)
Teachers who did not complete follow up (n = xx)
Teachers who discontinued intervention (n = xx)

Analysis

Analysed (n = xx schools, n = xx classrooms)
Students at baseline (n = xx)
Students at follow up (n = xx)
Parents at baseline (n = xx)
Parents at follow-up (n = xx)
Teachers at baseline (n = xx)
Teachers at follow-up (n = xx)
Excluded from analysis (n = xx schools, n = xx classrooms)
Students excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Parents excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Teachers excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Analysed (n = xx schools, n = xx classrooms)
Students at baseline (n = xx)
Students at follow up (n = xx)
Parents at baseline (n = xx)
Parents at follow-up (n = xx)
Teachers at baseline (n = xx)
Teachers at follow-up (n = xx)
Excluded from analysis (n = xx schools, n = xx classrooms)
Students excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Parents excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Teachers excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Analysed (n = xx schools, n = xx classrooms)
Students at baseline (n = xx)
Students at follow up (n = xx)
Parents at baseline (n = xx)
Parents at follow-up (n = xx)
Teachers at baseline (n = xx)
Teachers at follow-up (n = xx)
Excluded from analysis (n = xx schools, n = xx classrooms)
Students excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Parents excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

Teachers excluded (n= xx)
- Outlier (n = xx)
- Other Reasons (n = xx)

*Follow-up is considered to be post-test administration.

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Annex G

Project information

Information on the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project for students

_____, _____
[city] , [date].

What is this research about?
As you may know, some schools in your country and in other European countries use the Positive Behaviour Support model, that we call from now on PBS, to make schools safer and healthier. PBS-schools use values and expectations to teach and practice good behaviour.

We would like to invite you to be part of a new exciting project that wants to see if new technologies, like Augmented Reality (AR), can help teachers to teach and students to manage their behaviour better. With this project and this research, we want to see if using AR technologies at school can help you learn and practice expected behaviour in a positive and funnier way. Do you know what Augmented Reality means? It means using a mobile device (a tablet or a smartphone, for example) to visualize pictures, words, 3D animations, and other stuff that teach you something new about an object you are framing with your camera.

Who is doing this research?
This is a European project coordinated by Professor Eleni Mangina from the School of Computer Science at University College Dublin in Ireland. For this project she will work with universities, technological companies, and research institutions. Would you like to know who are the researchers working in this project? They are Dutch researchers from Vrije Universiteit Amsterdam, a university in the Netherlands, and Italian researchers from the Italian Research Council (a research institution in Italy). If you want to know more about the other researchers involved, please go to the following link http://www.areteproject.eu/team/.

Why have you been invited to take part?
Teachers are always looking to make school and their lessons more meaningful, attractive, and easier to learn. This research is a great opportunity to help your teachers create new exciting lessons to realise safe and healthy schools. But also to help children like yourself, not only here in Netherlands or Italy but worldwide, learn how to behave according to your school values.
We are asking children aged 10 to 12 years from schools using PBS and other schools to participate in this research.

What will happen if you decide to take part in this research?
First of all, you will be invited to answer questions about yourself. For example, we will ask you to answer some questions about your emotions and your relationships with your parents, friends, and other people. We will also ask you to describe your involvement in scholastic activities and your experience at school with your classmates and teachers.

Your classroom will be assigned to one of three groups. One group will use a mobile app with Augmented Reality during behavioural lessons; the app will show 3D animations explaining how to perform an expected behaviour and how to avoid unwanted behaviour according to your school's values and expectations. You will also be asked to do some reflections and other activities with your teacher. Your teacher will give you the instructions to use the app. Students from classrooms in the second group will participate in behavioural lessons as they usually do, without using the Augmented Reality app. Classrooms in the third group will not participate in any specific lesson teaching positive behaviour, because they are from schools without any implementation of PBIS. However, please do not worry if you are in the second or third group because you will be able to use the app at the end of the project. This research period involves approximately nine months.

Once the behavioral lessons programme of the first two groups is finished, you will be asked to answer questions again about yourself, and your experience at school with your classmates and teachers regardless of the group you will be assigned to. If you were in the PBS classrooms (supported by AR and PBS as usual), you will be asked to answer some questions about your experience of the lessons done during the research. If you were in the classroom assigned with using the AR app, you will also be asked questions about the use of the application.

How will your privacy be protected?
We will collect a lot information during the study. The data collected from this study will be kept private. Your name will not be used, and no one who reads about our study will know it was you. We keep things locked up, secured and de-identified so only the researchers involved in the research can see them.

What are the benefits of taking part in this research study?
Your participation in this research will help us develop new technologies and digital tools for education in behavioural management. The benefits from this study are conditional on taking part in the study and can benefit you, your parents, your teachers, and your school. You will learn social skills and behavioural tools using a funny and easy to use mobile app with Augmented Reality.
You and your parents will be aware of how the solution can support your learning of expected behaviour in a school setting.

What are the risks of taking part in this research study?
Being in this study will bring you no harm. On the other hand, it might help you to learn how to behave in classroom and in other locations respecting the school values and expectations using Augmented Reality. It will hopefully help us know more about how these new technologies can contribute to your learning expected behaviour and to your and your classmates' well-being at school.

Can you change your mind at any stage and withdraw from the study?
If you decide to not participate in this study, your grades will not be negatively affected. You can also stop participating in the study at any time without giving the reason. If you want to stop participating in the study,

please tell your parents/legal guardians and they will notify the researchers of the project. If you choose to stop before we are finished, any answers you already gave will be destroyed. There is no penalty for stopping. You will not receive any reward if you participate in the study as this is on a voluntary basis, however you may benefit behaviourally and academically.

If you would like to take part in this research or get further information, please ask your parent(s)/guardians to send us their contact details.

Contact details for further information
For more information on the ARETE project please visit www.areteproject.eu or email arete@ucd.ie.

For more information on the research and the pilot study, please email:

- Prof. Eleni Mangina at arete@ucd.ie(UCD, Ireland).
- Prof. Sui Lin Goei at sl.goei@windesheim.nl (SVU, Netherlands)
- Dr. Giuseppe Chiazzese at giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Please note that separate consent forms will need to be filled in before participation can take place.

Project Information

Information on the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project for School Management, Teacher, and Parents.

_____,_____
[city] , [date].

What is this research about?
This pilot study is part of the **A**ugmented **R**eality **I**nteractive **E**ducational **S**ystem (ARETE) project. The aim of ARETE is to deliver Augmented Reality (AR) solutions to increase the effectiveness of existing educational approaches across different subjects (English literacy, STEM, behavioral management). AR is an interactive experience in which reality is enriched with virtual (computer-generated) extensions, like videos, 3D animations, and text.

The pilot study you will be involved in is focused on the introduction of AR content within the framework of Positive Behavior Support (PBS). PBS is an approach developed in the United States to guide schools in creating systems that establish the social culture and individualized behavior supports needed for a safe and effective learning environment. This approach provides schools with accurate systematic implementation and use of evidence-based practices related to behaviour management in a multitiered system of behavior support.

The main idea is that AR can be effectively used to create new mobile interactive learning environments that may further facilitate students' acquisition of behavioral management skills as promoted within the PBS approach. We think that AR may provide students with an engaging learning environment where educational materials can be practised with increased motivation. Moreover, visuals provided by AR can represent effective environmental cues for learning and reinforcing of positive and expected behaviours.

Who is doing this research?
The ARETE project is funded by a Horizon2020 grant from the EUROPEAN COMMISSION Directorate-General for Communications Networks, Content and Technology. The project is coordinated by Dr. Eleni Mangina, from the School of Computer Science in UCD, in partnership with several European partners (http://www.areteproject.eu/team/). Specifically, this pilot study will be conducted and coordinated, among other partners, by researchers of Consiglio Nazionale delle Ricerche (CNR, Italian Research Council, Italy) and Vrije Universiteit Amsterdam (VU, Netherlands).

Why have you been invited to take part?
By taking part in this pilot study you can help us to generate the next generation of tools to help educate children not only here in your school and country, but should this initiative show itself to be useful, we see this tool being used by children worldwide. We are looking for children aged 10-12 years attending Dutch and Italian primary schools, which either have at least more than one year of experience of PBS implementation (experimental groups) and schools who do not have any previous experience with PBS (control group). In this way, we can compare PBS schools who use AR, PBS schools who only use PBS, and schools who do not use PBS. During the pilot study,

students will be engaged in scheduled classroom and school activities which will differ on the basis of the type of educational intervention they will participate in (PBS supported by AR, PBS as usual, and control).

What will happen if you decide to take part in this research study?
Classrooms will be assigned to three different conditions: 1) PBS intervention supported by the use of AR, 2) PBS intervention as usual, in schools implementing PBS; and 3) no specific intervention for supporting students' positive behaviour, in schools without any implementation of PBS (serve as control).

Students in classrooms assigned to the two PBS interventions (supported by AR and PBS as usual) will participate in behavioural lessons and other educational activities conducted by their teachers within the PBIS framework. Students in the control condition will not participate in any PBIS-based educational activity.

In order to assess the impact of the educational intervention supported by AR, students assigned to all the experimental groups (PBS supported by AR, PBS as usual, and control) will be asked to complete a number of questionnaires to evaluate their behavioral, social and, emotional characteristics, such as their ability to regulate behaviour and emotions, prosocial skills, and perceived self-worth. Other questionnaires will be administered to evaluate their perceptions of the school- and classroom-based experience, especially in terms of perceived school safety and their teachers' role in maintaining a positive and safe school and classroom climate. Students in the classrooms assigned with using the AR application will also be asked questions about the use of the application. Data about the user interaction with the AR application will be collected. Moreover, audio and video recordings of students' behaviour will be collected, during the research study, through the AR application; recordings will be stored only locally on the mobile devices used during the behavioural lessons for obtaining teachers' rating of students' behavioural skills. After the rating, each video will be deleted from the local devices. The AR application will not transfer videos on the Internet network.
Parents and teachers will be asked to complete questionnaires about their children's social, behavioural, and emotional characteristics, such as their behavioural and emotional regulation and prosocial skills. Finally, teachers and school administrators will complete questionnaires, make observations and/or are interviewed for evaluation purposes (e.g. teaching practice, perception of school climate, fidelity of implementation of the intervention). The evaluation will take place before and after the PBS educational intervention (supported by AR and as usual) to see if there has been an impact from experts, regardless of students' group assignment (PBS intervention supported by AR, PBS intervention as usual, no intervention for supporting students' positive behaviour as control). The data can be collected using on-line and/or paper-based solutions.
Schools who do not receive the PBS-AR intervention, will be allowed to use the application in the year after the pilot study.

How will your data be used?
The project will develop a mobile interactive learning environment supported by AR technology to stimulate students' acquisition and practice of positive and expected behaviors.
Data collected during this pilot will be used to evaluate the impact of the developed learning environment on students' behavioral outcomes and skills, and on student's and school educational staff's perception of school and classroom climate and safety.
Arrangements will be in place throughout the pilot study to ensure that the identity of each participant remains confidential and all data collected from this pilot study will be anonymous and/or de-identified.

How will your privacy be protected?
All paper files will be held in lockable and fireproof cabinets. All online data will be protected using Transport Layer Security (TLS) and its predecessor, Secure SSL (Secure Sockets Layer) Certification, which are the standard

security technology for establishing an encrypted link between a web server and a browser. All collected data held for the project on a website/database will be de-identified and encrypted for security. All database backups are encrypted. All files will be destroyed 6 years after the completion of the project. Audio and video recordings of students' behaviour will be stored locally on the mobile device and will be used only for monitoring of educational processes. Audio and video recordings will be deleted at the end of the educational activities.

What are the benefits of taking part in this research study?
Your participation in the ARETE project will help us develop new technologies and digital tools for education. The aim of this pilot study focuses in particular on the development of a new and more engaging educational approach for behavioral management learning based on the integration of existing technologies (mobile apps and augmented reality development) into established and validated evidence-based practices as provided by the PBS framework.

We hope that students, teachers, and schools as inclusive learning environments will benefit from such an approach mainly in terms of increased behavioral outcomes, and eventually academic outcomes. Moreover, results from this pilot study will give teachers the opportunity to learn the main principles guiding the effective pedagogical and didactical integration of different digital solutions into existing educational behavioural practices.

What are the risks of taking part in this research study?
There is minimal risk to participants in taking part in this research project. We will ensure that all adults (except parents) in contact with children during this project are Garda vetted. The ARETE project, in general and specifically for the activities of this pilot study, will follow the indications of the ARETE External Ethics Advisory Board and will follow the highest standards in relation to confidentiality, data protection and anonymity.

Can you change your mind at any stage and withdraw from the study?
Yes, if at any time you decide that you do not wish to participate you may withdraw and there are absolutely no negative consequences for you, your school, or your child/student in choosing not to participate. Should you choose to withdraw it will not affect your child(s)/student(s)' treatment in any way and you do not need to provide a reason why you want to withdraw. If you choose to withdraw from the study before it is finished, any data linked to your participation will be destroyed. There is no penalty for withdrawing. If you decide that you do not want your materials in the study but you already have provided them, contact the researchers involved in the pilot study (see the contact details below). You will not receive any money if you do the study as this is on voluntary basis, however you may benefit academically and behaviourally.

How will you find out what happens with this project?
Once the entire ARETE project is completed and the results have been published, the findings of this pilot study will be published in the ARETE website. However, please be advised that all data collected are anonymised and de-identified, so the report you will receive will contain only aggregate data and not personalised information.

Contact details for further information
For more information on the ARETE project please visit www.areteproject.eu or email arete@ucd.ie.

For more information on the research and the pilot study, please email:

- Prof. Eleni Mangina at arete@ucd.ie(UCD, Ireland).
- Prof. Sui Lin Goei at sl.goei@windesheim.nl (SVU, Netherlands)
- Dr. Giuseppe Chiazzese at giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Please note that separate consent forms will need to be filled in before participation can take place.

Annex H

Teachers consent form for participation in the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project

1. I have read and understood the information leaflet for the ARETE pilot study.

2. It was explained to me what it means to consent with participation in the study. My questions have been answered. I had enough time to decide about my consent for this project.

3. I voluntarily consented with participation in the study. I am aware of my ability to revoke my consent at any time during or after the project, without any consequence and without substantiating my reasons for this.

4. I am aware that some individuals—the researchers mentioned in the information form—are allowed to view my data for research purposes.

5. I understand that my data will be treated confidentially and anonymously for research purposes. This means that the data and published results cannot be traced back to me personally.

I give consent for participation in this project.	YES:	NO:
I give consent for storing de-identified data collected from me and through the use of the PBS-Augmented Reality mobile app for up to 6 years after this project is finished.	YES:	NO:
I give consent to use de-identified data collected from me and through the use of the PBS-Augmented Reality mobile app for the research purposes mentioned in the information form.	YES:	NO:
I give consent to use data collected from me and through the use of the PBS-Augmented Reality mobile app anonymously for the following other purposes:		
- Publications and conference presentations	YES:	NO:
- Future research (pending new ethical review)	YES:	NO:
- Sharing my and PBS-Augmented Reality mobile app data for research purposes	YES:	NO:

If you have questions about the project and the study, contact:

Researcher's Names:

- Dr. Eleni Mangina (ARETE Project Coordinator), arete@ucd.ie (UCD, Ireland)
- Dr.Sui Lin Goei (PBS coordinator, s.l.goei@vu.nl (VU Amsterdam, Netherlands)
- Dr. Giuseppe Chiazzese (Pilot 3 Coordinator) , giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Name (in block letters): _____

Role (e.g. teacher/school staff member): _____

School: _____

Signature: _____

Date: _____

Please return this to your school.

Student consent form for participation in the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project

1. I have read the information leaflet describing the ARETE project and pilot study with a parent or guardian.

2. I understand what the project is about and what taking part means for me. My questions have been answered. I've had enough time to make my decision about taking part in the project.

3. I voluntarily consent to participate in the project. I have the right to change my mind at a later time, without any consequence and without explaining my reasons for this.

4. I understand that the researchers mentioned in the information form are allowed to view my data for research purposes.

5. I understand that my data will be treated confidentially and anonymously for research purposes. This means that the data and published results cannot be traced back to me.

I give consent for my participation in this project.	YES:	NO:
I give consent for storing de-identified data collected from me and through the use of the PBS-Augmented Reality mobile app for up to 6 years after this project is finished.	YES:	NO:
I give consent to use de-identified data collected from me and through the use of the PBS-Augmented Reality mobile app for the research purposes mentioned in the information form.	YES:	NO:
I give consent to use data collected from me and through the use of the PBS-Augmented Reality mobile app anonymously for the following other purposes:		
- Publications and conference presentations	YES:	NO:
- Future research	YES:	NO:
- Sharing my and PBS-Augmented Reality mobile app data for research purposes	YES:	NO:

Note: Your parents or guardians will also receive an information letter and will be asked to sign a different consent form.

If you have questions about the project and the study, tell your parents to contact:

Researcher's Names:

- Dr. Eleni Mangina (ARETE Project Coordinator), arete@ucd.ie (UCD, Ireland)

- Dr.Sui Lin Goei (PBS coordinator, s.l.goei@vu.nl (VU Amsterdam, Netherlands)
- Dr. Giuseppe Chiazzese (Pilot 3 Coordinator), giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Name of the student (in block letters): _____

School: _____

Class: _____

Signature: _____

Date: _____

Please return this to your school.

School Managers consent form for participation in the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project

1. I have read and understood the information leaflet for the ARETE pilot study.
2. It was explained to me what it means to consent with my and my school participation in the study. My questions have been answered. I had enough time to decide about my and my school's consent for this project.
3. I voluntarily consented with my and my school participation in the study. I am aware of my ability to revoke my and my school's consent at any time during or after the project, without any consequence and without substantiating my reasons for this.
4. I am aware that some individuals—the researchers mentioned in the information form—are allowed to view data collected from me and at my school for research purposes.
5. I understand that the data collected from me and at my school will be treated confidentially and anonymously for research purposes. This means that the data and published results cannot be traced back to me and my school.

I give consent for my and my school participation in this project.	YES:	NO:
I give consent for storing de-identified data collected from me and at my school for up to 6 years after this project is finished.	YES:	NO:
I give consent to use de-identified data collected from me and at my school for the research purposes mentioned in the information form.	YES:	NO:
I give consent to use data collected from me and my school anonymously for the following other purposes:		
- Publications and conference presentations	YES:	NO:
- Future research (pending new ethical review)	YES:	NO:
- Sharing my and my school's data for research purposes	YES:	NO:

If you have questions about the project and the study, contact:

Researcher's Names:

- Dr. Eleni Mangina (ARETE Project Coordinator), arete@ucd.ie (UCD, Ireland)
- Dr.Sui Lin Goei (PBS coordinator, s.l.goei@vu.nl (VU Amsterdam, Netherlands)
- Dr. Giuseppe Chiazzese (Pilot 3 Coordinator) , giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Name (in block letters): _____

Role (e.g. school manager/school management member): _____

School: _____

Signature: _____

Date: _____

Please return this to your school.

Parent/legal guardian consent form for participation in the Pilot Study conducted within the Augmented Reality Interactive Educational System (ARETE) Project

1. I have read and understood the information leaflet for the ARETE pilot study.

2. It was explained to me what it means to consent with participation of me and my child in the study. My questions have been answered. I had enough time to decide about my consent and the consent of my child for this project.

3. I voluntarily consented with my and my child's participation in the study. I am aware of my ability to revoke my and my child's consent at any time during or after the project, without any consequence and without substantiating my reasons for this.

4. I am aware that some individuals—the researchers mentioned in the information form—are allowed to view my and my child's data for research purposes.

5. I understand that my and my child's data will be treated confidentially and anonymously for research purposes. This means that the data and published results cannot be traced back to me and my child personally.

I give consent for my and my child's participation in this project.	YES:	NO:
I give consent for storing de-identified data collected from me, my child, and through the use of the PBS-Augmented Reality mobile app for up to 6 years after this project is finished.	YES:	NO:
I give consent to use de-identified data collected from me, my child, and through the use of the PBS-Augmented Reality mobile app for the research purposes mentioned in the information form.	YES:	NO:
I give consent to use data collected from me, my child, and through the use of the PBS-Augmented Reality mobile app anonymously for the following other purposes:		
- Publications and conference presentations	YES:	NO:
- Future research (pending new ethical review)	YES:	NO:
- Sharing data for research purposes	YES:	NO:

If you have questions about the project and the study, contact:

Researcher's Names:

- Dr. Eleni Mangina (ARETE Project Coordinator), arete@ucd.ie (UCD, Ireland)
- Dr.Sui Lin Goei (PBS coordinator, s.l.goei@vu.nl (VU Amsterdam, Netherlands)
- Dr. Giuseppe Chiazzese (Pilot 3 Coordinator), giuseppe.chiazzese@itd.cnr.it (CNR, Italy)

We welcome any questions you may have about this project.

Name of child (in block letters):

_____

School:

_____

Name of parent(s)/legal guardian(s) (in block letters):

_____

Signature(s): _____

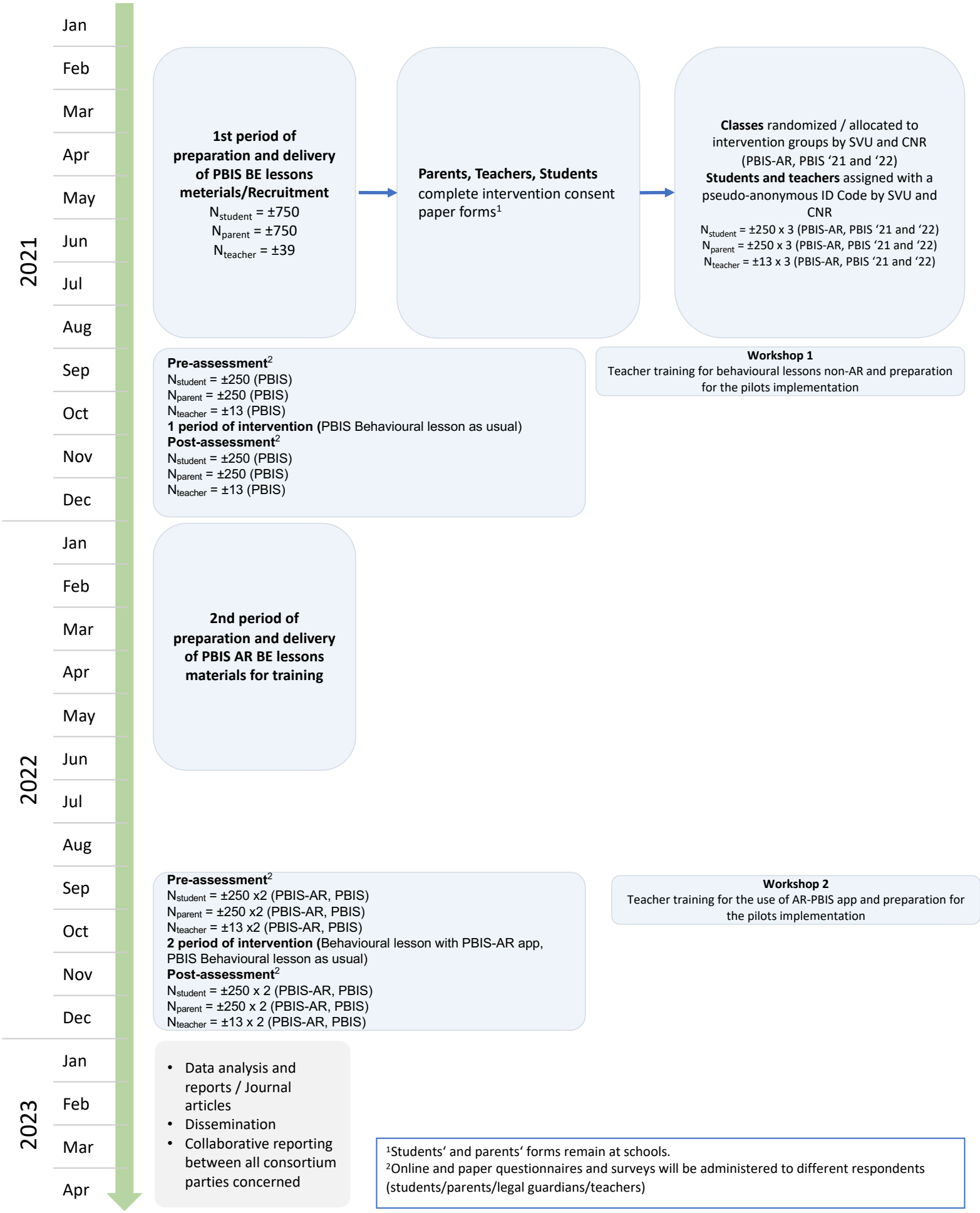
Date: _____

Please return this to your school.

Annex I

Partner Name/Participant schools	Pilot No	Name of Record	Data Subjects	Categories of Personal data	Special Category data	Purpose of procesing	Source of data	General Description Of Technical And Org. Security Measures	Retention Period	Categories Of Recipients	Basis For Transfer	Role Of Partner In Data Sharing	Third Countries/ Internat. Orgs That Personal Data Are Transferred To	Safeguards For Exceptional Transfers Of Personal Data To Third Countries Or International Organisations
IT school	3	Applications for Research and privacy consent	Applicants (teachers, parents/guardians and their children)	Name and Surname, School Name, Classroom, Role, Home address, Signature	N/A	Pilot 3 Recruiment of data Subject	Data Subjects	Locked Filing Cabinet	6 years	N/A	N/A	Data processor	N/A	N/A
CNR (IT)	3	Pre/Post questionnaires	Applicants (teachers, parents/guardians and their children)	Responses to the questionnaires: Students, parents, & teachers: Answers on behavioral strengths (i.e., prosocial behavior) and difficulties (i.e., internalizing and externalizing behavioral problems), executive functioning. Students & teachers: experiences with using the PBIS-AR application; Students: frequency of occurrence of challenging behavioral incidents on the individual level Teachers: frequency of occurrence of challenging behavioral incidents on classroom level Students only: classroom and school climate, self-perceived competences, abilities, and self-worth. Teachers only: students' ability to perform the learned behaviors, fidelity assessment.	N/A	Research investigation about the How does AR impact on students' positive behavioral management and self-management skills	Data Subjects	Secure server. Data deleted from server once Anonimysation process is applied. Access with secure https protocol to the server and identification code for the server access	6 years	N/A	N/A	Data Controller	N/A	N/A
CNR (IT)	3	Video recorded by the use of PBIS-AR app	school students	Video of performed Behavioural routine	N/A	Teacher Evaluation process of performed behavioural routine	Data Subjects	Video recording by the AR-PBIS app saved in the reserved space allocated to the application of the mobile device	Time elapsed from the recording to the teacher	N/A	N/A	Data Controller	N/A	N/A
CNR (IT)	3	PBIS-AR app User Interface Interaction	School students	AR interaction data/behavioural routine rating	N/A	Research investigation about the How does users use the AR objects	Data Subjects	Secure server.	6 years	N/A	N/A	Data Controller	N/A	N/A
CNR (IT)	3	Technical cookies from web service for questionnaires	Applicants (teachers, parents/guardians and their children)	Session Technical information	N/A	Cookies are used to navigate or to provide a service requested by the user. They are not used for further purposes and are normally installed directly by the website owner.	Data Subjects	They are used exclusively to the extent this is necessary to enable secure, efficient browsing. Storage of session cookies in terminal equipment or browsers is under the user's control, whilst cookie-related information is stored server-side in the logs file of HTTP service.	The storage in the service logs is usually no longer than seven days like all other browsing data.	N/A	N/A	Data Controller	N/A	N/A

Partner Name/Participant schools	Pilot No	Name of Record	Data Subjects	Categories of Personal data	Special Category data	Purpose of procesing	Source of data	General Description Of Technical And Org. Security Measures	Retention Period	Categories Of Recipients	Basis For Transfer	Role Of Partner In Data Sharing	Third Countries/ Internat. Orgs That Personal Data Are Transferred To	Safeguards For Exceptional Transfers Of Personal Data To Third Countries Or International Organisations
NL school	3	Applications for Research and privacy consent	Applicants (teachers, parents/guardians and their children)	Name and Surname, School Name, Classroom, Role, Home address, Signature	N/A	Pilot 3 Recruiment of data Subject	Data Subjects	Locked Filing Cabinet	6 years	N/A	N/A	Data processor	N/A	N/A
SVU (NL)	3	Pre/Post questionnaires	Applicants (teachers, parents/guardians and their children)	Responses to the questionnaires: Students, parents, & teachers: Answers on behavioral strengths (i.e., prosocial behavior) and difficulties (i.e., internalizing and externalizing behavioral problems), executive functioning. Students & teachers: experiences with using the PBIS-AR application; Students: frequency of occurrence of challenging behavioral incidents on the individual level Teachers: frequency of occurrence of challenging behavioral incidents on classroom level Students only: classroom and school climate, self-perceived competences, abilities, and self-worth. Teachers only: students' ability to perform the learned behaviors, fidelity assessment.	N/A	Research investigation about the How does AR impact on students' positive behavioral management and self-management skills	Data Subjects	Secure server. Data deleted from server once Anonimysation process is applied. Access with secure https protocol to the server and identification code for the server access	6 years	N/A	N/A	Data Controller	N/A	N/A
SVU (NL)	3	Video recorded by the use of PBIS-AR app	school students	Video of performed Behavioural routine	N/A	Teacher Evaluation process of performed behavioural routine	Data Subjects	Video recording by the AR-PBIS app saved in the reserved space allocated to the application of the mobile device	Time elapsed from the recording to the teacher	N/A	N/A	Data Controller	N/A	N/A
CNR (IT)	3	PBIS-AR app User Interface Interaction	School students	AR interaction data/ behavioural routine rating	N/A	Research investigation about the How does users use the AR objects	Data Subjects	Secure server.	6 years	N/A	N/A	Data Processor	N/A	N/A
SVU (NL)	3	Technical cookies from web service for questionnaires	Applicants (teachers, parents/guardians and their children)	Session Technical information	N/A	Cookies are used to navigate or to provide a service requested by the user. They are not used for further purposes and are normally installed directly by the website owner.	Data Subjects	They are used exclusively to the extent this is necessary to enable secure, efficient browsing. Storage of session cookies in terminal equipment or browsers is under the user's control, whilst cookie-related information is stored server-side in the logs file of HTTP service.	The storage in the service logs is usually no longer than seven days like all other browsing data.	N/A	N/A	Data Controller	N/A	N/A



[1]Students' and parents' forms remain at schools.
[2]Online and paper questionnaires and surveys will be administered to different respondents (students/parents/legal guardians/teachers)

ARETE Pilot 3 · Assessment Strategy

Annex K

ARETE

Main Research Question: How does AR impact on students' positive behavioral management and self-management skills?

Students, parents, & teachers

Online procedures: SDQ and BRIEF-2.

Pre/Post: September 2021 - December 2021
Pre/Post: September 2022 - December 2022

$N_{student}$ = ±250 x 3 (PBIS-AR, PBIS '21 and '22)
N_{parent} = ±250 x 3 (PBIS-AR, PBIS '21 and '22)
$N_{teacher}$ = ±13 x 3 (PBIS-AR, PBIS '21 and '22)

Instrument characteristics

The SDQ allows for pre- and post-intervention assessment of students' behavioral strengths (i.e., prosocial behavior) and difficulties (i.e., internalizing and externalizing behavioral problems) and the BRIEF-2 allows for the pre- and post-intervention assessment of students' executive functioning (i.e., behavioral regulation and metacognition). Both questionnaires are filled in from the perspective of the student, parent, and teacher. The SDQ takes between 5-10 min. to complete by one student or for one student. The BRIEF-2 takes approx. 15 minutes to complete by one student or for one student.

Handling of Data

Pseudo-anonymous raw data (i.e., data linking over time enabled through random user identification numbers) will be sent and stored on a safe VU-server for the Netherlands and a CNR-server for Italy. Data will be pre-processed to final variables using standard procedures. All data will be stored for at least 10 years post-project on a safe VU-server.

Analysis (January 2023– April 2023)

Calculating descriptive statistics.
Comparisons of pre- and post-intervention results for the experimental condition (PBIS-AR classrooms) and comparison of the effectiveness of the PBIS-AR intervention (i.e., pre- vs. post-intervention) with the traditional PBIS intervention (standard PBIS classrooms) run in 2022. Comparison of the effectiveness between the traditional PBIS interventions run in 2021 and in 2022

Students & teachers

Online procedures: IMI and Occurrences.

Pre/Post: September 2021 - December 2021
Pre/Post: September 2022 - December 2022

IMI:
$N_{student}$ = ±250 (PBIS-AR)
$N_{teacher}$ = ±13 (PBIS-AR)

Occurrence Questionnaire
$N_{student}$ = ±250 x 3 (PBIS-AR, PBIS '21 and '22)
$N_{teacher}$ = ±13 x 3 (PBIS-AR, PBIS '21 and '22)

Instrument characteristics

The IMI allows for post-intervention assessment of students' and teachers' experiences with using the PBIS-AR application (e.g., engagement utility, and motivation). The Occurrence Questionnaire (OQ) allows for pre- and post-intervention assessment of the frequency of occurrence of challenging behavioral incidents on the individual level (students) and classroom level (teachers). The IMI and OQ both take 5-10 min. to complete (student or teacher).

Handling of Data

Pseudo-anonymous raw data (i.e., data linking over time enabled through random user identification numbers) will be sent and stored on a safe VU-server for the Netherlands and a CNR-server for Italy. Data will be pre-processed to final variables using standard procedures. All data will be stored for at least 10 years post-project on a safe VU-server.

Analysis (January 2023– April 2023)

Calculating descriptive statistics.
Comparisons of pre- and post-intervention results for the experimental condition (PBIS-AR classrooms) and comparison of the effectiveness of the PBIS-AR intervention (i.e., pre- vs. post-intervention) with the traditional PBIS intervention (standard PBIS classrooms) run in 2022. Comparison of the effectiveness between the traditional PBIS interventions run in 2021 and in 2022.

Students only

Online procedures: BRI, CCS, SCS, and SPPC.

Pre/Post: September 2021 - December 2021
Pre/Post: September 2022 - December 2022

$N_{student}$ = ±250 x 3 (PBIS-AR, PBIS '21 and '22)

Instrument characteristics

The BRI allows for pre- and post-intervention assessment of students' behavioral involvement in the classroom social dynamics (e.g., bullying, victimization, bystander behavior, likeability, friendship). The CCS and SCS allow for pre- and post-intervention assessment of students' views of the classroom and school climate respectively. The SPPC allows for pre- and post-intervention assessment of students' self-perceived competences, abilities, and self-worth. The BRI takes between 15-20 min. to complete. The CCS and SCS both take between 5-10 min. to complete. The SPPC takes between 10-15 min. to complete.

Handling of Data

Pseudo-anonymous raw data (i.e., data linking over time enabled through random user identification numbers) will be sent and stored on a safe VU-server for the Netherlands and a CNR-server for Italy. Data will be pre-processed to final variables using standard procedures. All data will be stored for at least 10 years post-project on a safe VU-server.

Analysis (January 2023– April 2023)

Calculating descriptive statistics.
Comparisons of pre- and post-intervention results for the experimental condition (PBIS-AR classrooms) and comparison of the effectiveness of the PBIS-AR intervention (i.e., pre- vs. post-intervention) with the traditional PBIS intervention (standard PBIS classrooms) run in 2022. Comparison of the effectiveness between the traditional PBIS interventions run in 2021 and in 2022.

Teachers only

Online procedure: Learned behaviors, BoQ, TFI.

Pre/Post: September 2021 - December 2021
Pre/Post: September 2022 - December 2022

$N_{teacher}$ = ±13 x 3 (PBIS-AR, PBIS '21 and '22)

Instrument characteristics

The Learned behaviors rating procedure allows for pre- and post-intervention assessment of students' ability to perform the learned behaviors during the PBIS-AR intervention (behaviors are rated by teachers in all conditions). The BoQ and TFI allow for pre- and post-intervention fidelity assessment of (internal: BoQ; external: TFI) PBIS program implementation (not administered to the control condition). The Learned behaviors teacher rating procedure and BoQ are expected to take approx. 10 min. to complete. The TFI is a 60 min. online assessment through an interview with the school PBIS team leader.

Handling of Data

Pseudo-anonymous raw data (i.e., data linking over time enabled through random user identification numbers) will be sent and stored on a safe VU-server for the Netherlands and a CNR-server for Italy. Data will be pre-processed to final variables using standard procedures. All data will be stored for at least 10 years post-project on a safe VU-server.

Analysis (January 2023– April 2023)

Calculating descriptive statistics.
Comparisons of pre- and post-intervention results for the experimental condition (PBIS-AR classrooms) and comparison of the effectiveness of the PBIS-AR intervention (i.e., pre- vs. post-intervention) with the traditional PBIS intervention (standard PBIS classrooms) run in 2022. Comparison of the effectiveness between the traditional PBIS interventions run in 2021 and in 2022

Technical data

A set of data related to the user's interaction with the PBIS-AR app will be collected. Consideration is underway regarding additional features that could provide data collection.
The data would be pseudo-anonymized and stored in a repository of the ARETE Consortium.

Instrument characteristics

The PBIS-AR app supports the behavioural teaching process allowing students to learn, practice, and reinforce positive behavioural routines using 3D AR objects.
Video recordings of students' behaviour will be collected through the use of the PBIS-AR app. The students will video record each other for evaluation purposes.
The development of the PBIS-AR app is Work-in-Progress.

Handling of Data

Pseudo-anonymous data will be collected from the interaction of users with the PBIS-AR app and AR objects.
Video recordings will not be sent to any server but will reside exclusively on the device and deleted after the evaluation.

Analysis (Jul 2023-Apr 2023)

Future descriptive analysis and statistics, still yet to be determined, but may include e.g. Tracking:

- Use of 3D AR objects for behavioural learning
- Learning process
- Practice achievements

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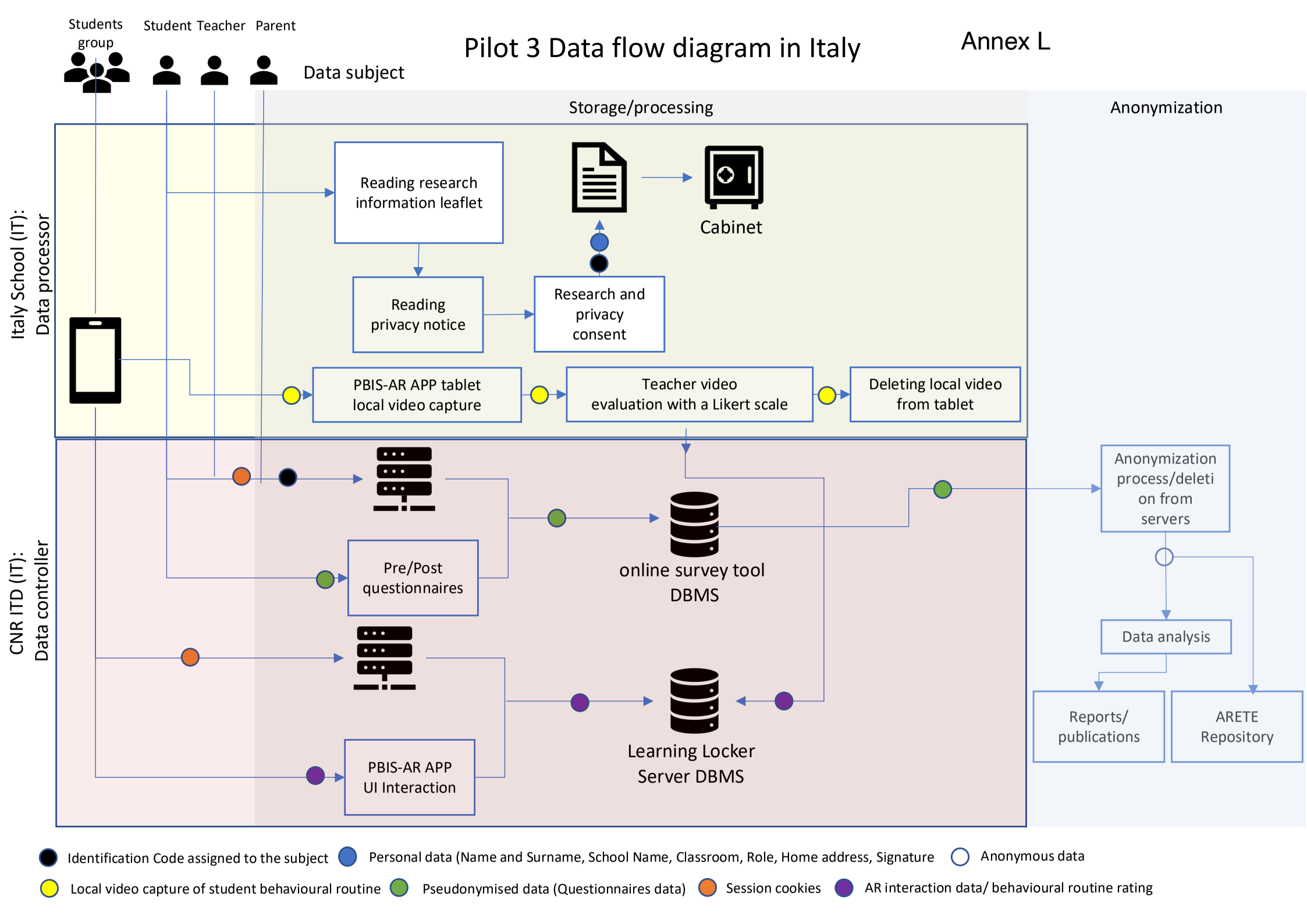
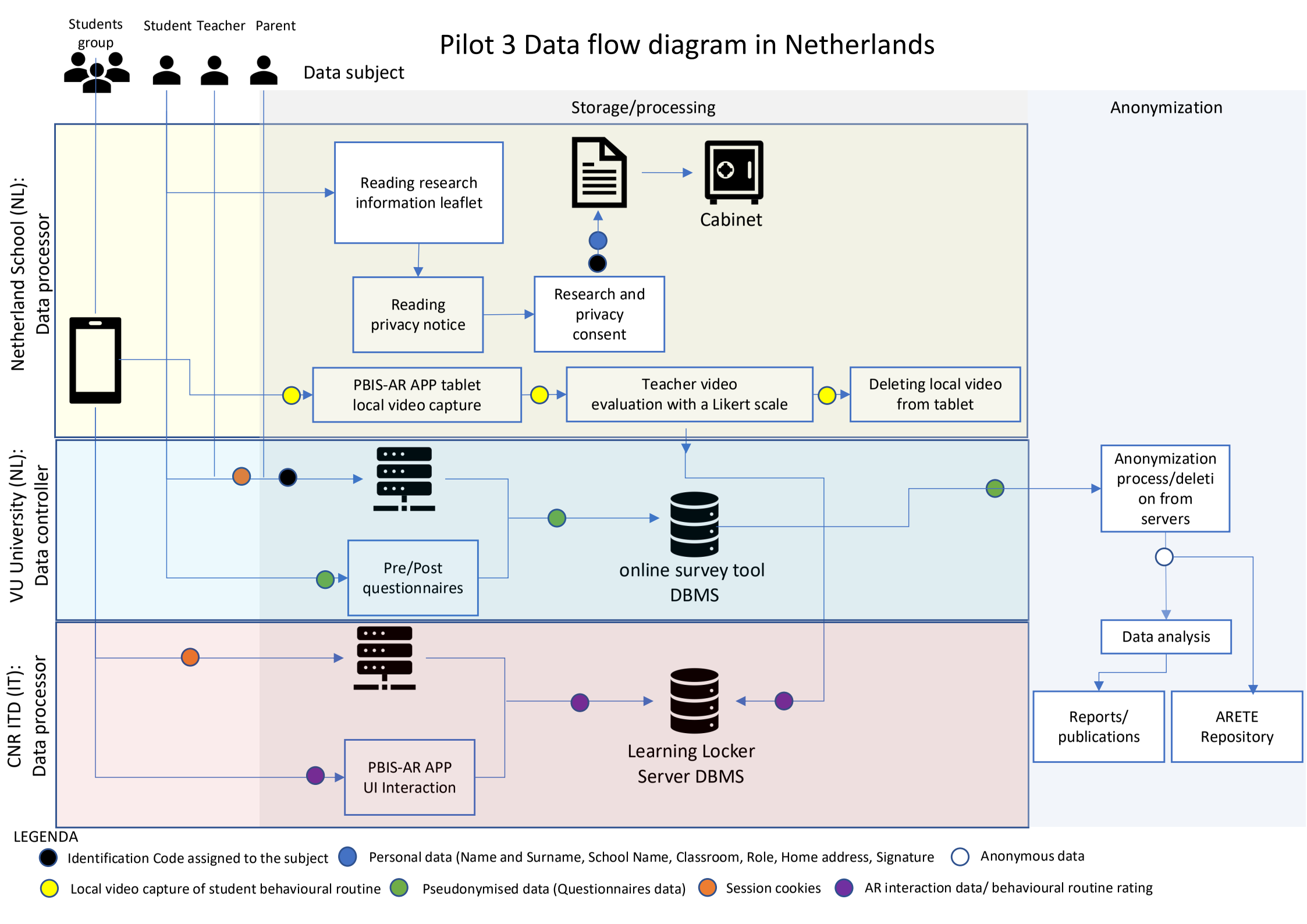
Data analysis and reports,
Journal articles
Dissemination
Collaborative reporting between all consortium parties concerned

Pilot 3 Data flow diagram in Italy

Annex L




Pilot 3 Data flow diagram in Netherlands
Students group
Student
Teacher
Parent
Data subject
Storage/processing
Anonymization
Netherland School (NL): Data processor
Reading research information leaflet
Cabinet
Reading privacy notice
Research and privacy consent
PBIS-AR APP tablet local video capture
Teacher video evaluation with a Likert scale
Deleting local video from tablet
VU University (NL): Data controller
Pre/Post questionnaires
online survey tool DBMS
Anonymization process/deletion from servers
Data analysis
Reports/ publications
ARETE Repository
CNR ITD (IT): Data processor
PBIS-AR APP UI Interaction
Learning Locker Server DBMS
LEGENDA
Identification Code assigned to the subject
Personal data (Name and Surname, School Name, Classroom, Role, Home address, Signature
Anonymous data
Local video capture of student behavioural routine
Pseudonymised data (Questionnaires data)
Session cookies
AR interaction data/ behavioural routine rating

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