frontiers | Frontiers in Computer Science

TYPE Original Research
PUBLISHED 30 September 2022
DOI 10.3389/fcomp.2022.968137

Check for updates

OPEN ACCESS

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SPECIALTY SECTION
This article was submitted to
Human-Media Interaction,
a section of the journal
Frontiers in Computer Science

RECEIVED 13 June 2022
ACCEPTED 01 September 2022
PUBLISHED 30 September 2022

CITATION
Massler U, Müller W, Iurgel I, Haake S, Gantikow A and Hadzilacos T (2022) Meaningful, gamified training of reading fluency.
Front. Comput. Sci. 4:968137.
doi: 10.3389/fcomp.2022.968137

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Meaningful, gamified training of reading fluency

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Improving learners' reading is of importance. The digital world is centred on the written word, and today's labour market requires high literacy levels. Furthermore, the development of school and foreign language skills among learners, especially those of weaker learners, is crucial as the effects of globalisation allow for increased work mobility and the necessity for lifelong learning. GameLet provides effective training scenarios for reading fluency, a prerequisite for reading comprehension, in schools with gamified, self-guided, personalised, media-based individual and collaborative learning, thereby allowing educators to intensify and extend learning activities to out-of-school settings. At the core of GameLet lies the production of a podcast by the learners that encourages them to read repeatedly, hence improving their reading fluency, and to successfully record their role in a digital *Recording Studio*. Increasing reading fluency is targeted by means of media-supported individual and cooperative learning phases with various training methods. Furthermore, GameLet implements meaningful digital media-based Gamification mechanisms for the purpose of increasing student motivation. The software is web-based and was developed with a focus on user-centred design and an agile and design-based approach. Prototype development followed an iterative and participative process, in which students and teachers of three participating partner countries interacted with the developed materials. Artefacts were tested in both face-to-face and online settings. GameLet exemplifies the successful application of Gamification for improving and extending classical learning scenarios at school as well as the design of effective learning technologies that are meaningful, gamified, effective and usable.

KEYWORDS

reading fluency, Gamification, media-based learning, seamless learning, multilingualism, Design-based research, learning software for schools

Introduction

Reading aloud in order to practise good reading fluency (the skill of reading aloud correctly, meaningfully, and engagingly) used to be common practise in language teaching and learning, particularly for a learner's first language (technically: L1), but also for "foreign" languages (technically: L2).

After falling out of favour, reading fluency (RF) training in L1 became an important part of L1 language instruction again in the first two decades of this century as research findings demonstrated a close link between RF and reading competence for L1 (National Reading Panel, 2000). The relatively small amount of research currently available indicates that RF is also significant for L2 learners (see Grabe, 2009; Reynolds, 2014). Research strongly suggests that effective reading training practise should be based on repeated reading (repetitious reading of a problematic text), assisted reading (assisting a learner with reading problems), and model reading (providing the opportunity for learners to listen to and imitate a model reader) (National Reading Panel, 2000). These requirements for appropriate RF instruction are not easy to meet in school settings because they are time and resource intensive (Jamshidifarsani et al., 2019). Beyond that, teachers are already challenged by the increasing heterogeneity of their classes due to migration with students from different cultural backgrounds and lack of language skills. Thus, in a classroom setting, if all students were to be given the chance to read aloud, the time corresponding to each one would be grossly insufficient. Furthermore, some students find repeated reading aloud activities to be monotonous, which reduces their motivation to practise (Massler et al., 2019). Hence, new approaches are needed to provide more attractive and individualised student support and personalisation of learning and training activities. Specifically, solutions are required that support the extension of corresponding learning activities to individual out-of-school learning phases, for instance in terms of homework, in line with the concept of "seamless learning" (Milrad et al., 2013). Therefore, the central research interest of the development and research project GameLet is how the aforementioned disadvantages of reading promotion programmes can be overcome with the help of digital tools or a digital learning environment. The project team's approach to solving this problem was to develop a digital environment to promote reading skills using an innovative concept that enables comprehensive self-directed and personalised learning activities.

The development and testing of the didactic-methodological and technical design were implemented in accordance with the Design-based research approach (DBR). In the DBR approach, the elaboration of pedagogical interventions follows several development phases under scientifically evaluated conditions. Thus, development and research are not regarded as two different, successive processes. More precisely, the design of the RF training environment, i.e., the design itself, is the object of research. Thus, the GameLet design was developed theoretically and practically in cycles together with small groups of students and teachers, tested and revised in accordance with the evaluation results. Unfortunately, the originally planned summative evaluation of the completed environment in the school context over the course of several months was not possible due to the COVID-19 pandemic.

The GameLet learning design draws from the Multilingual Readers' Theatre (MELT), in which groups of students practise RF using multilingual, dialogical texts until they are able to read them aloud fluently and expressively and present them in plenum. The readers' theatre (RT) is one of the reading aloud methods able to achieve significant improvement in the area of RF with regard to correct word recognition, reading speed and prosody while also significantly increasing motivation to read among young learners (Tyler and Chard, 2000; Mraz et al., 2013). MELT and RT both are based on a playful, role-playing based, narrative approach, and therefore represent an excellent basis for the design of gamified RF training scenarios and digital tools supporting those. The development of a digital system based on the previous approaches promises increased efficiency, easier structuring of the learning process, online collaboration, seamless learning at home and at school, and a more satisfying user experience for the digital natives, among others. The addition of layers of Gamification makes it possible to structure an engaging learning experience across several learning sessions, giving the students a sense of purpose from beginning to end in the learning unit.

The remainder of the paper is structured as follows: In Section State of the art, we describe the concept and importance of RF and give an overview of Gamification. Next, we describe the GameLet learning environment, the instructional and the Gamification concepts and their technical realisation. Then, we explain the chosen agile and design-based approach, and further methods used to conceptualise and implement the learning scenarios, Gamification and related tasks. The following describes how the gamified learning scenario, the Gamification approach, and the *Recording Studio*, a central component of the GameLet approach, were developed. For all these aspects, the description focuses on the DBR-driven cyclical development, testing, evaluation and redesign. Subsequently, we discuss key results of interviews and surveys from the different assessment rounds. Finally, the article reflects on limitations as well as possibilities and concludes with a summary.

State of the art

Reading fluency

The results of major reading achievement studies in the last decade have revealed an increase of deficits in reading literacy in school and foreign languages, among primary and lower secondary education in many European countries, among them the GameLet project countries, Cyprus, Portugal, and Germany [(Organisation for Economic Co-operation Development (OECD), 2016, 2019)]. For example, in Germany, the results of the Progress in International Reading Literacy Study (PIRLS) revealed that from 2001 to 2016, the proportion of students with reading difficulties rose from 16.9 to 18.9%

(Mullis et al., 2017). Stated differently, one fifth of all primary students in Germany show deficits in school-language reading skills (Bundesministerium für Bildung und Forschung, 2017). Inadequate reading competence leads to poor and superficial understanding and thus can negatively impact the whole learning process.

As RF has a bridging function between decoding performance and text comprehension, it is of central importance for the acquisition of reading competence in the first language (Grabe, 2009). A fluent reader is one who is able to read effortlessly. Thus, RF is the ability to automatically decode the words in a text with accuracy and speed—the ability to read without slowing down in order to comprehend individual words (Vasinda and McLeod, 2011). RF consists of four dimensions: decoding accuracy, automatisation, reading speed and intonation, and must be taught systematically (Rosebrock and Gold, 2018). Only when all four dimensions of RF function in a satisfactory range, is it possible for textual statements to be constructed and learned from texts (Rosebrock and Gold, 2018). However, school children acquire the ability to read fluently at different rates and, above all, at different levels of proficiency. There may be various reasons for these differences—for example, cognitive ability, acquired knowledge of letters, and phonological processing ability may also be important (Bowey, 2005).

Acquiring satisfactory RF in a foreign language is equally important for these learners to be able to cope with a greater degree of foreign language input (Grabe, 2009). Moreover, improved foreign language skills help learners to become more motivated to read. There is evidence that foreign language RF is connected both to first language reading skills and to the nature of the foreign language, which may differ linguistically at varying degrees from the first language. This points to a relationship between RF in a learner's first and second languages, which suggests that RF can be transferred from one language to the next (script universal) (Pasquarella et al., 2015) and be acquired across languages with an approach such as MELT (Kutzelmann et al., 2017).

The promotion of RF, reading accuracy and reading comprehension can be achieved through repetitive reading methods (National Reading Panel, 2000). Reading aloud methods (e.g., repeated reading, paired reading) target the level of the reading process. They promote fluent reading, where words and word sequences are grasped as a whole. In this way, children practise word recognition until little if any mental effort is required (Bowey, 2005). In particular, repeated reading enhances learning, builds automaticity and increases reading pace; thus, learners perform better when reading the same passage (Muzammil and Andy, 2018). The use of a recorded reading model, i.e., an auditory model, in repetitive reading activities, provides essential gains in oral reading, accuracy and text comprehension (Young and Rasinski, 2009; Taguchi et al., 2012). Furthermore, learners who use audio files are more autonomous and depend less on their teachers or classmates as they can practise their reading role on their own. With regard to foreign language passages, models are especially helpful for learning correct pronunciation as they eventually help to prevent pronunciation errors. Additionally, studies have provided evidence that repeated reading with guidance and feedback from teachers and classmates boosts RF in L1 (National Reading Panel, 2000) and in a foreign language as well (Muzammil and Andy, 2018).

The reading forms used in the reading promotion methods RT and MELT commonly follow the three principles of repeated, assisted and model reading. For RT and thus also for MELT, literary texts are transformed into dialogical read-aloud texts (Martinez et al., 1999; Shepard, 2004). The dramatised texts contain narrator and character roles, which are written in direct speech (Nix, 2006). Creative reading aloud of these texts is trained in cooperating student work groups and finally performed. In contrast to traditional theatre, readers' theatre is not usually staged or performed through physical movement. The interpretation of the dramatic reading is based almost exclusively on the voices of the actors. MELT expands the traditional RT by means of a bilingual or multilingual approach, thereby responding to socio-political demands for increased multilingual competence (Kutzelmann et al., 2017). MELT takes advantage of multilingualism within a student body and uses it as an opportunity for integrating migrant languages. Furthermore, it is able to provide a cooperative learning setting in which the heterogeneity of the students is seen as a resource. In this setting, students with stronger reading skills support those with weaker skills by acting as reading models and providing feedback (Kutzelmann et al., 2017). MELT was developed with the DBR approach in several cycles and additionally researched through an acceptance study (Kutzelmann et al., 2017). Results from the study showed that teachers see a clear benefit (Götz et al., 2017) and appreciate the clearly structured, varied didactic-methodological design in MELT with its easily available, dramatised texts. Multilingualism appears to be predominantly unproblematic and, according to the teachers, offers a clear added value ("relative advantage," Venkatesh et al., 2003) for reading training in school and foreign languages compared to conventional language teaching. Other design components, such as the integration of migration languages, reading aloud by the teacher, cooperative learning, etc., were also judged very positively (Götz et al., 2017). However, a more comprehensive long-term study surveying the development of RF in MELT is lacking to date. Nevertheless, since MELT uses central practise principles such as repeated reading, the use of reading models and supported reading, whose positive effect on the promotion of RF has been proven by studies, in a targeted and intensive way, it can be assumed that the promotion of RF is possible with regular and frequent use (Götz et al., 2017).

As effective as read-aloud methods may be, their use also poses challenges. First of all, they are time-consuming (Jamshidifarsani et al., 2019). Additionally, many of these methods require a reading partner for efficient practising—a condition that might be difficult to meet outside of the classroom (Durski et al., 2020). Furthermore, according to project team observations, some students experience repeated reading aloud activities as monotonous, which reduces the motivation to practise (Massler et al., 2019). It is precisely these difficulties, further accentuated by greater learner heterogeneity, that GameLet addresses with its media-based, gamified design.

Gamification

"Gamification" is a process in which individual game elements or mechanics are integrated into contexts not originally intended as games. More precisely, Deterding et al. (2011) describe this approach very generally in their widely accepted and used definition as "the use of game design elements in non-game contexts" (p. 10). A Gamification design process does not necessarily lead to a proper game, but will always target an increase in motivation and engagement through some sort of play, and subsequently a better performance. Gamification can be particularly beneficial for digital learning environments that rely on self-directed learning activities, which can suffer from low motivation. Consequently, education and training have become a major application area of Gamification, aimed at fostering learning through increased motivation, higher engagement and immersive joy of play (Kapp, 2012).

Game elements frequently applied in non-game environments are points, badges, and leaderboards. Nicholson (2015) refers to corresponding approaches as *Reward-based Gamification*. Similar generic strategies can be applied to virtually any learning context. Kahoot! (Kahoot! Inc., 2022) is a typical example of reward-based Gamification for the classroom. Students participate with their own device in quiz rounds, get points for correct answers, see their performance on a leaderboard, and measure and compare themselves with others (Bicen and Kocakoyun, 2018; Kaur and Naderajan, 2019). Classcraft (Classcraft Studio Inc., 2022) is another example of a commercial system that offers a series of generic tools to implement Gamification in the classroom by means of role-playing. Students become part of a fantasy world, taking on game-like roles such as warriors, mages, and healers and collaborating in teams. Teams are awarded points based on performance (Papadakis and Kalogiannakis, 2017). The role-playing game metaphor of Classcraft already suggests "meaningful" Gamification (see next paragraph), but Classcraft's approach remains reward-based Gamification at its core. Effects on student learning and engagement have not yet been fully explored (Papadakis and Kalogiannakis, 2017).

In which cases and how Gamification may enhance engagement, immersion, and learning effects, is part of an ongoing controversy. A reward-based system does not automatically add the joy of play to a learning context, and may even lead to a medium-term drop in motivation (Martens and Müller, 2016). *Meaningful Gamification* has been proposed as a countermeasure. This approach stresses the importance of narrative and player-created storytelling, authentic gaming experiences, immediate and comprehensive feedback, and reflection (Becker and Nicholson, 2016). In the context of gamified learning activities, this is well in line with the concept of meaningful interaction in learning (Woo and Reeves, 2007). "Meaningful" approaches to Gamification are less generic than badges and points, and require understanding of and adaptation to specific subject areas. While Nicholson formulates principles of a "recipe for Meaningful Gamification" Nicholson (2015), it is still considered an open question how such principles may be applied in practise to specific areas, and how learning scenarios may be successfully enriched with corresponding elements. GameLet presents a specific approach and contribution to this discussion, applying storytelling and narrative in such a way that these not only provide a coherent framework for (learning) activities, but also provide a link between corresponding learning objectives and trainings to situations where corresponding skills and competences are required and helpful.

In language learning, games have been studied as an important resource for improving students' motivation, engagement, and learning success (Dehghanzadeh et al., 2021). Results, in particular the experience of flow, were shown to depend on individual characteristics, conditions in the environment, and even on other participants (Egbert, 2004). These dependencies suggest that a "one size fits all" approach is not feasible—no gamified learning strategy is likely to be equally beneficial and joyful to each and every student in class. This is one of the reasons for GameLet to integrate a variety of approaches: while it gives the most weight to Meaningful Gamification, rewards are also offered in order to attend to a range of inclinations and circumstances of individual students.

STREEN (Story Reading Environmental Enrichment; Ribeiro et al., 2018) employs Gamification in the context of RT. It is an immersive multimodal reading and learning environment. It enriches the reading experience of primary school children by allowing them to collaboratively define, control and add non-verbal representations (e.g., illustrations, sound and light effects) to texts. These "enrichments" are triggered when the RT performance takes place. Unlike GameLet, STREEN focuses on a final performance, and does not employ a narrative, role-playing framework to connect the preparatory steps. Furthermore, GameLet encompasses self-directed, seamless learning at home, in school or in other contexts (Milrad et al., 2013) to complement corresponding classroom

activities, whereas STREEN addresses group activities at school.

The GameLet learning environment

Instructional concept

The following sections first give a brief overview of the GameLet learning process. Specifically, they describe the learning objectives that learners need to master in order to improve their RF and the corresponding learning scenario related to recording a well-performed podcast. This is followed by a detailed description of the work process that the learners go through to create their podcast.

In accordance with MELT, the gamified GameLet environment is centred around the production of a bilingual RT script that is in a school language (L1), i.e., the language of instruction, and in English (L2), by a group of students to foster RF across several languages. At the beginning of the game, the learners are recruited by a director to replace his absentee audio speakers in a podcast production which will be shared with their classmates in the classroom, their friends and families. In the story, students meet relevant people typically involved in the production and marketing of a podcast: from the drama and reading coach to the marketing department employee. To produce the podcast, the students must familiarise themselves with the text and learn to read it aloud appropriately and expressively in order to be able to record the podcast at the end. Consequently, GameLet's instructional scenario exploits MELT's strength in which the opportunity to perform for an audience is provided, thereby offering an authentic and meaningful purpose for repeated RF practise. Thus, the production of a podcast is the objective of the main game, but at the same time, the acquisition of the ability to read aloud for a podcast is the main learning goal. The podcast consists of a dramatised bilingual reading text, the so-called readers' theatre script, which consists of several scenes. The aim is for the pupils to work on one scene each from this play in small groups and to practise it repeatedly so that they can record it fluently and expressively as a podcast at the end. To achieve this goal, students need to improve their reading skills in both their L1 and L2. Consequently, at the beginning and repeatedly throughout the production process, students are instructed that the common goal of all GameLet activities is to produce a podcast of which they can be proud and that accordingly, every activity is geared towards a better understanding of the story, and towards the acquisition of the necessary language and reading skills that will help them improve their podcast. By comparing their own recordings at different stages, students become aware of their improved RF, which further illustrates the meaningfulness of the learning steps. Additionally, creating a real life product shows them "what they can do" with better reading skills.

The sequence of tasks during the unfolding story is based on the MELT learning process (Kutzelmann et al., 2017). In GameLet, the learning stages of MELT are represented in terms of learning missions. Each mission is part of the story and addresses one or more learning objectives.

The mission table provides an overview of the learning activities within the learning environment (see Table 1). As can be seen, all learning activities can be found across several missions, thereby fostering repeated training of corresponding skills (compare Massler et al., 2020). The objectives behind the learning activities, which are important for the development and promotion of good RF are as follows:

1. Know and understand the story and characters in the RT scene (green frame).
2. Understand and learn the vocabulary used in the scene (red frame).
3. Practise reading the role aloud with others and on one's own (blue frame).
4. Give and receive feedback on group members' reading aloud production (purple frame).

Getting to know vocabulary (missions 1&2)

Linguistic understanding of a text and adequate pronunciation are prerequisites for reading with proper intonation and emphasis. Thus, while first reading their podcast script, the students need to identify unknown words and learn about their meaning and pronunciation. In GameLet, this is supported by the dictionary functionality (see Figure 1) and by the game *Word Cloud* (see Figure 2). With the help of the GameLet software, students can annotate their podcast scripts and add comments on language, interpretation or intonation (see Figure 1). The students can add unknown words to a digital word cloud (see Figure 2). Then, the teacher focuses on translation, pronunciation and meaning of the word cloud items.

Introducing story and characters (missions 1–3)

An adequate literary understanding of the scenes and of the whole podcast is fundamental for improving the overall prosodic composition of the reading. The *Picture Quiz* game allows students to become acquainted with the story by depicting a central scene of the story hidden behind square fields. The fewer the fields needing to be uncovered in order to identify the story, the more points the students can win (see Figure 3). Games such as the *Order Story Parts* support student understanding of the story's literary key elements such as plot, characters, conflicts and settings. This type of game also uses an image central to the story. By dragging and dropping text parts hidden behind the illustrations (these appear by moving the cursor over them) and placing them

TABLE 1 Overview of GameLet missions and the corresponding learning objectives (frames 1 to 4) at which the learning process is aimed.

Mission 1	Mission 2	Mission 3	Mission 4	Mission 5
Introducing story & language	**Introducing specific scenes & language**	**Describing scenes & characters**	**Practising roles & scenes**	**Recording rehearsal & final recording**
1 Introducing Story I • Finding out about the story: *Picture Quiz* • Getting to know the story: *Putting the story in the right order* • *Teacher reads aloud + Listening comprehension*	**Introducing Story II** • *Reading the scene and summaries*	**Introducing Characters** • *Drawing your scene* • Filling in a *Digital Character Card* • Getting to know the emotions of the characters with *Emoji Tales*	**3 Practising individually** • *Prepare your text* • Reading aloud your role • Reading while listening • RR with digital reading partner • Recording your role **Practising collaboratively** • Tandem reading • Mirror reading	**Practising cooperatively** • Recording a rehearsal of your scene • Giving and receiving feedback • Improving reading and recording final version of your scene • Upgrading your podcast in the Podcast Shop
2 Getting to know vocabulary • *Words & their pronunciation*	**Consolidating vocabulary** • *Word Cloud I* • *Word Cloud II*		**4 Asking for, giving, and receiving feedback** (individually and in groups)	

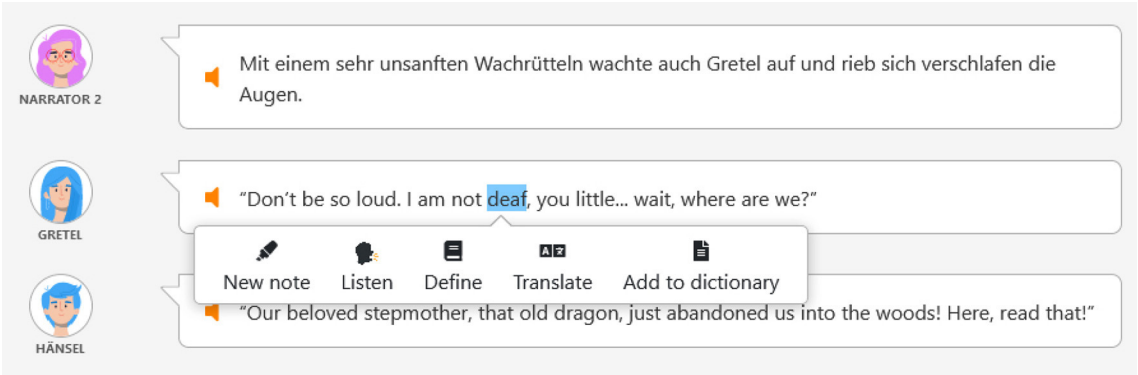

FIGURE 1
Functionality to identify and highlight unknown vocabulary, to add notes, to listen to model pronunciation and to add it to a learner's dictionary in the *Recording Studio*.

into an input window in their correct order, students create a summary of the story (see Figure 4). Later, students produce a summary of their own scene and read summaries from peers in order to get to know the whole story (Massler et al., 2020). Another example is the *Digital Character Card* which students fill out to describe the characteristics of their role, thus, text understanding is also fostered. These tasks are also designed to arouse the students' curiosity and motivation for the podcast production.

Practising reading aloud individually and cooperatively (missions 3–4)

First, students focus on the correct decoding and pronunciation of the words. With increasing automatisation and repetition at the word and sentence level, they can concentrate on how the scenes are divided into meaningful and cohesive sections, their accentuation, intonation and pauses (Kutzelmann et al., 2017). In contrast to other approaches, as Jamshidifarsani et al. analytical review on technology-based

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FIGURE 2
Example of the digital word cloud, a tool to be used by students to collect and visualise unknown words in the script that they find. Word size corresponds to the number of students that marked a word as "unknown".

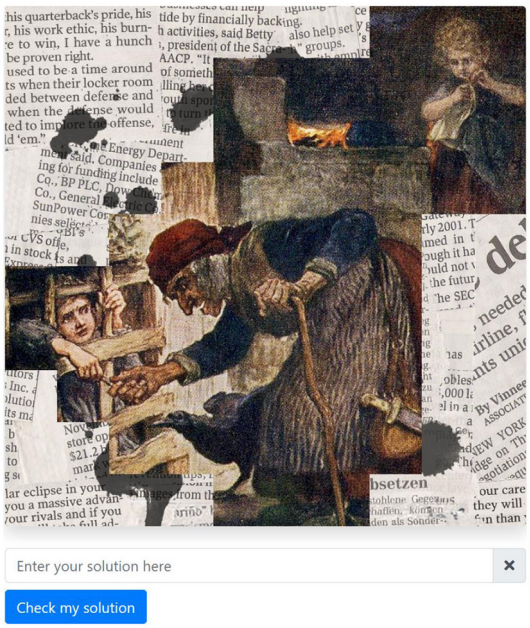

FIGURE 3
Example of the *Picture Quiz*, a game element where students have to uncover the script of a central scene before reading.

or technology-assisted RF interventions for elementary grades showed (Jamshidifarsani et al., 2019), GameLet applies well-rounded concepts for improving RF. It takes RF's complex and multifaceted nature into account by addressing different components of RF at various levels. Consequently, some learning activities focus on accuracy, speed or automaticity, whereas others emphasise proper intonation.

Additionally, its media-based design is founded on best practise principles of fostering RF such as assisted reading, repeated reading and model reading. To support this, the *Recording Studio*, the core of GameLet, was designed, which enables learners to practise their RF individually and cooperatively. It allows them to record, select and delete texts themselves, listen to texts read and recorded by other students and give written and oral feedback on them. It also includes recorded reading models, i.e., an auditory model, which lead to essential gains in oral reading, accuracy, and text comprehension (see Figure 5). For individual practise, the *Recording Studio* offers students the opportunity to practise reading while listening to an audio model and to read aloud with a digital (virtual) reading partner, both difficult for students outside the classroom setting (Durski et al., 2020).

In the *Emoji Tales* activity, a game that makes use of the *Recording Studio*, students practise recognising and understanding emotions in their podcast text. Learners first read a passage of text, listen to the corresponding audio model and try to identify the correct emotion by selecting an emoji image (see Figure 6).

Asking for, giving, and receiving feedback (individually and in groups) (missions 4–5)

The *Recording Studio* allows students to share their individual and group recordings with their peers and their teacher. The learning environment is also innovative as it provides additional guidance and feedback tools—aspects necessary for improving student RF (see Figure 7). Several tasks require learners to give feedback to their peers, for which they are given a criteria grid to support them. This trains their perception of what good fluent reading is and thus also supports them in their own development.

User scenarios

GameLet's instructional design is founded on best practise principles of fostering RF such as assisted reading, repeated reading and model reading, where corresponding roles of tutors and training partners may be taken by the GameLet software. As such, GameLet supports intensive training activities during individual and cooperative learning at school and particularly also at home. Hereby, GameLet allows extending individual RF training time for students compared to training in school. This is crucial because research shows that by having students repeatedly read passages orally, their reading accuracy, RF, and comprehension improve (National Reading Panel, 2000). In this context, GameLet foresees several application scenarios of the learning technologies and instructional materials.

Extended training in class

GameLet may be applied by teachers in class in individual and collaborative training slots to accompany

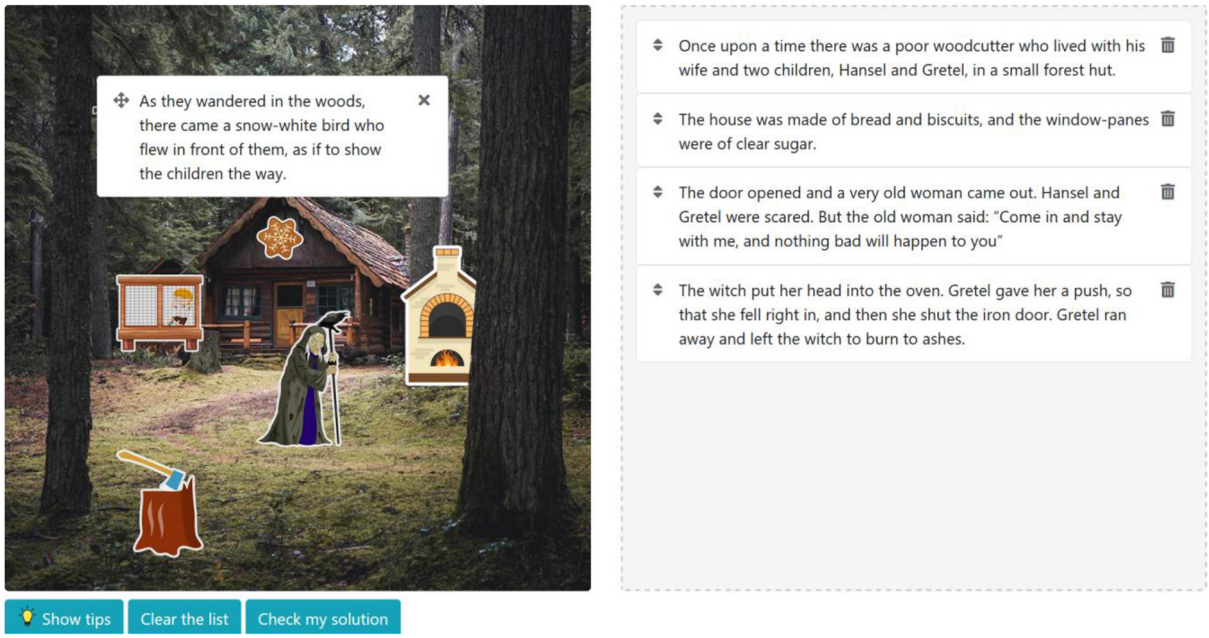

FIGURE 4
Example of the game *Order Story Parts'* game element, where students drag and drop text parts into an input window to create a summary of the Hansel and Gretel fairy tale.

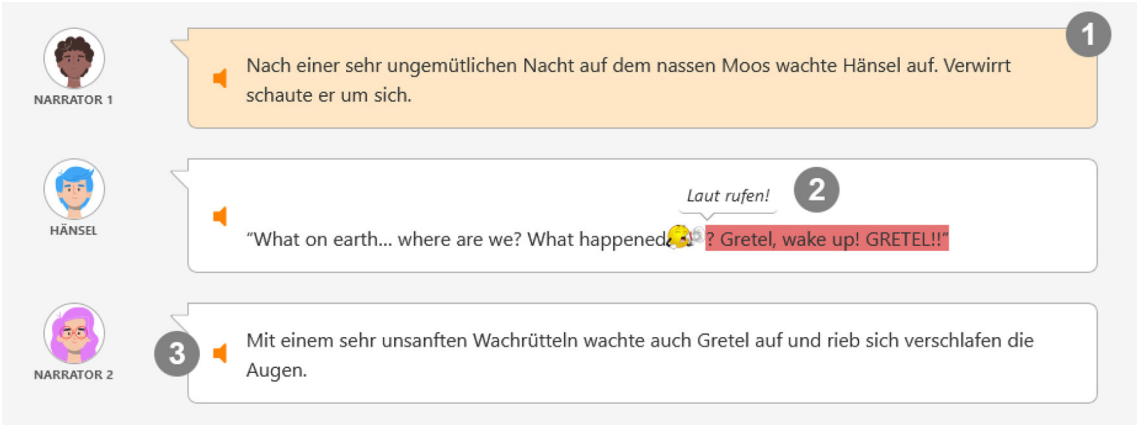

FIGURE 5
(1) The GameLet UI highlights the role assigned to a student to facilitate orientation. (2) Students can also comment on the various kinds of moods and forms of speaking that are a part of their texts. (3) They can listen to audio models of their own and others' roles when clicking on the loudspeaker icon.

class teaching in terms of self-contained training units. For this, GameLet supports the individual alignment of training activities (e.g., selection of specific training activities) by teachers to allow for individualised training times.

Extended training at home

GameLet also supports moving individual and collaborative training slots out of class to take place at home. In this context, it is also possible for teachers to provide individual feedback (for instance, on individual audio recordings) and to

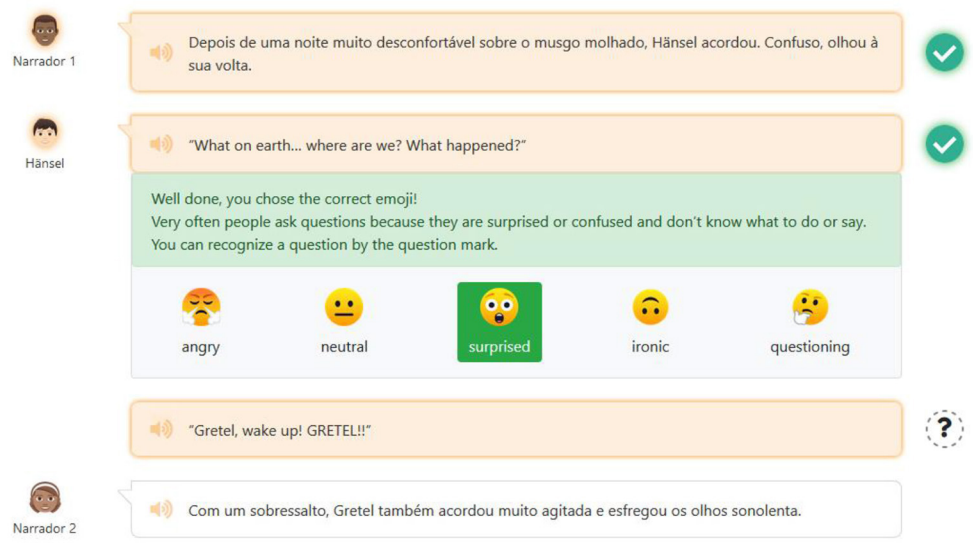

FIGURE 6
In the *Emoji Tales* activity, students practise recognising and understanding emotions in their podcast text. To do this, they first read a passage of text, listen to the corresponding audio model and try to identify the correct emotion by selecting an emoji image.

personalise learning activities of students based on individual demands, something that might be more difficult to achieve in synchronous learning activities in class.

Accompanying training tool for RT and MELT in class

GameLet is specifically suitable to be applied in the context of RT and MELT activities at school. The main narrative and missions naturally connect to corresponding methods and learning objectives. To allow for closer linking, GameLet allows for the replacement of scripts related to RT training and podcast generation, providing the means to use other sources of literature and theatre plays. However, to also support model reading activities, a corresponding audio recording will have to be provided.

Virtual, hybrid, and seamless learning

Since GameLet can be applied in school and at home, it is also specifically suitable to support completely virtual learning activities, such as distance learning as required due to COVID-19. Here, the scenario would be similar to the extended training in class, with the difference that learners stay at home and are accompanied by the teacher from a distance. This scenario can easily be extended to hybrid teaching, with some of the students in school and some at home. With this, GameLet provides an approach to seamless learning in the context of RF training at schools.

Applied Gamification

The main design principle of GameLet follows concepts of Meaningful Gamification (Nicholson, 2015), where the main game and learning goals are perceived as intrinsically identical, and the usefulness of the acquired competencies for authentic tasks is central and obvious. The production of a podcast is the main objective presented to students. Still, at the same time, the acquisition of the ability to read aloud for a podcast is communicated as the main learning goal. With this, it becomes clear that appropriate RF skills are mandatory to produce things such as podcasts, explicitly linking corresponding learning activities to meaningful real activities.

As effective as common RF programmes are, students' motivation to engage in these activities might fade quickly due to their monotony (Massler et al., 2019). Therefore, increasing RF practise in GameLet is targeted by means of media-supported application of playful learning scenarios and materials, and interactive elements. The RT motivational aspect to perform for an audience and thus create an authentic purpose for repeated RF practise is intensified in GameLet by the introduction of Gamification elements which aim at increasing students' motivation in self-directed RF learning and training phases. Classical reward-based Gamification elements (i.e., points) were added to the main GameLet design at a very reduced level, based on student demand. Here, we aimed at avoiding possible interferences with the Meaningful Gamification concepts as best as possible, aligning the award of points with existing mission objectives.

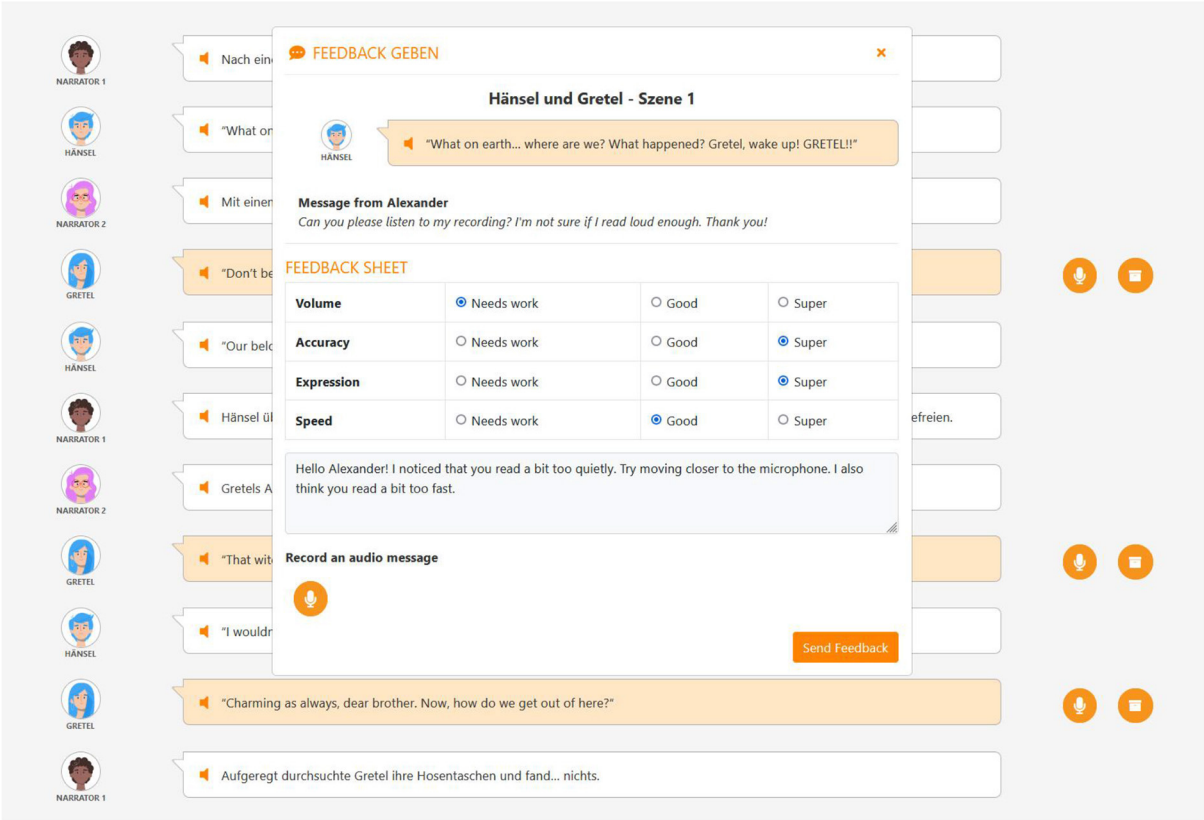

FIGURE 7
The criteria grid supports students in giving feedback and includes the most important aspects of RF (volume, accuracy, expression, and speed). It can be given orally or in written form.

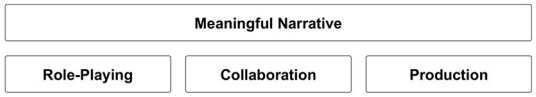

FIGURE 8
GameLet gamification building blocks.

GameLet's fundamental concepts of Gamification incorporate "game," "story," "play," "flow" and self-discovery with minimal risk of failure and frustration in a unique way. Many of the activities carried out within GameLet are "play" experiences that, by themselves, are novel, exciting and uplifting to most students. User experience, efficiency and attractiveness of the dedicated software and materials contribute to reaching "flow" (Kiili et al., 2014) (see Figures 3, 4, 6 for an example). A story assigns narrative roles, motivates the activities and structures the learning steps. In the following, Meaningful Gamification aspects of the GameLet learning environment are presented within a model of four main categories (see Figure 8).

Role-playing relates to a specific approach in GameLet based on play and exposition, targeted to give learners an active role in the gamified learning scenario and provide them with meaningful choices to interpret their roles in their own sense in a social context (Dawson and Lee, 2018). In GameLet, students first and foremost play themselves within the frame story and act as commissioned podcast speakers in the first person perspective. This also means that the experience they have in GameLet is always an experience that is directly related to themselves as a person. The plot is driven by short animated video clips. Within these clips, students are addressed directly by confronting new tasks or obstacles. Further, students also take on roles in the RT story, i.e., the story that they shall read aloud. In practising their roles, students have the freedom to give their roles a lively and characteristic tone. Students empathise with the role individually and fill it with life. However, role-playing is not necessarily a completely new Gamification approach in the context of RF training, since it is suggested by the instructional approach of RT (Tyler and Chard, 2000; Mraz et al., 2013), where it has already confirmed its effectiveness in fostering RF.

Collaboration is considered fundamental to games and game mechanics, targeted to foster motivation and encourage engagement in the sense that working together is better than working alone (Kanazawa, 2022). In the context of Gamification of learning, this mechanics is strongly linked to the concept of collaborative learning. GameLet is characterised by a collaborative team challenge. The objective of producing a podcast can only be achieved together as a group. In GameLet, collaborative team activities occur when students practise and record reading aloud their scripts together, which students experience to be a fun but also a very enriching experience. Additionally, collaboration also takes place in feedback rounds.

Production draws on the idea of making collaborative work on a final product (a podcast) the focus of the gamified learning activities. While relating to common Gamification mechanics such as social production (Chou, 2014), this again refers to well-established concepts from the field of learning, at the very end based also on concepts such as Constructivism (Papert, 1980, 1993). In GameLet, the production of a podcast represents the guiding objective. GameLet activities are structured around this goal, leading student teams through a number of activities where the results contribute to the final product. We believe that this can be a widely usable formula for devising gamified learning systems: Every student activity is centred around the task of creating some sort of digital product that requires specific competencies to produce it. The required competencies are the main final learning goals.

In the GameLet approach, a meaningful narrative represents the conceptual and operational umbrella for integrating the aforementioned Gamification concepts and learning activities. In this context, meaningful narrative relates to a well-chosen, authentic (background) story, providing a comprehensible and motivational context for learning and allowing for the integration of various relevant learning activities that are fun. Thus, meaningful narrative in our context is closely related to meaningful interaction in learning (Woo and Reeves, 2007) based on a story relating to an authentic learning scenario. In GameLet, this is achieved by a background story depicting the demand for a podcast to be shared with classmates in the classroom, friends and families. In the story, students meet relevant people typically involved in the production and marketing of a podcast: from the drama and reading coach to the marketing department employee. Carefully designed story elements related to individual learning activities drive the story forward, representing milestones on the way to successfully finishing the podcast production. For instance, a scene with a drama coach has been introduced to integrate a specific learning activity, where learners train how to read aloud with good emphasis in an interactive video.

The four GameLet Gamification principles listed above do not represent completely distinct concepts (see Figure 8). In fact, "role-play" is not possible without a narrative, and it also represents a collaborative activity. Similarly, "production" in our context is understood in terms of a team activity, therefore again linked to collaboration. However, the four GameLet Gamification principles stand for distinct dimensions of the general design space, and therefore represent fundamental design decisions with respect to the Gamification approach taken.

In response to the possible negative impact of competition in learning tools, we have devised the user experience such that it is not to be dominated by a rewards system or by user competitiveness. Nevertheless, the usage of points as additional awards can motivate and provide guidance, and some students actually enjoy and feel motivated by a clear and immediate reward system that they probably recognise from playing video games. For this reason, GameLet has adapted an approach where points are strictly provided in accordance with learning objectives. For example, points in missions 4 and 5 are awarded for repeated reading of the same texts, in order to provide training for weak readers in particular. At the end of the learning journey, students may utilise awarded points as a game currency to embellish the presentation of the automatically generated website of their podcast. Thus, student groups can create their own individual podcast presentations, buying assets like cover designs, avatars, music, etc. For instance, a student may receive up to 50 points for correctly finishing the *Order Story Parts* game, and similarly, she will acquire points for every other achievement. The group may then decide to use the collectively collected points to buy the aforementioned assets for the podcast website (see Figure 12) at the end of the GameLet experience.

The GameLet software system

The GameLet Software System (GSS) is web based and works on a browser, thus not requiring installation at schools. Tighter integration into Moodle was considered in the beginning of the project. Even a solution as a Moodle-plugin would have been technically possible, but would have limited usage to this platform and required additional efforts for administering the software at schools, among other unpractical shortcomings. Instead, we offer an implementation of the technical LTI-interface, which allows for quite limited data transfer between Moodle and the GSS. This facilitates the use of individual stand-alone elements of the GSS independent of their original context. For example, a teacher using Moodle with their own content and structure could add a link to a game or to the *Recording Studio* of GameLet, and use only these elements. Every other Learning Management System (LMS) can be employed, following this pattern, in this case without data transfer between applications. When a teacher wants to make use of all the Gamification and narrative mechanisms offered by GSS, a usage independent of any LMS is recommended, in order to avoid having to "jump" back and forth between applications. The GSS offers all required tools for independent usage. Participant

management functions include registering students, assigning them to a group and to a role, changing role and group membership, supervision, and communication/ feedback. GSS is a complex technical system based on web technologies such as node.js, REST API, Ajax, server-side rendering *via* the EJS templating engine, management of rendering and API *via* the Express Framework. It also exposes data to Learning Record Stores *via* xAPI (see Figure 9).

Methods

General methodology

GameLet followed a design-based approach in the development of the conceptualisation and implementation of the instructional scenarios, Gamification and corresponding technologies. This included a user-centred approach (Norman and Draper, 1986), in which target users were involved in the design of the materials under development. In addition, design and development were embedded into a Design-based research (DBR) methodology (Van den Akker et al., 2006; Anderson and Shattuck, 2012) with the objective that the process would also lead to new theoretical and empirically founded insight as well as methodological and pedagogical innovation and contributions, thus bringing the state of the art a step forward. The project was designed to develop innovative methodology and materials to promote RF. Overall, the development process integrated systematic design, testing, redesign, and reflection, all based on close cooperation among researchers and practitioners from school contexts, and involving frequent testing with students. Consequently, the following users and stakeholders were involved:

a. Average students with an aim to increase their RF.
b. Demotivated students who have failed—or are failing—in their development.
c. Students who have problems in their RF due to the fact that the school language is not their native language.
d. Schools that have a student population with the above characteristics (points a-c).
e. School administration and teaching staff of the above schools.

The schools (d) were selected based on whether they had students who fulfilled characteristics (a), (b) and/or (c) and whether they deemed these RF problems as critical and were willing to collaborate on solving them (a+b). The schools then identified the students through their own data and focused on involving them in the project. The students participated in the project and offered feedback through interviews. Their observational data was recorded. Half of each group of students were girls, as girls often are more likely to be media-disadvantaged. Balanced gender participation was insisted upon, even though it would have been easier in some cases to attract mainly boys to participate in the trials. Learners with reading difficulties due to a migration background or due to inadequate development of reading skills were also represented, as well as learners who read well, avidly and with pleasure. Furthermore, learners with and without a high affinity to computers were also in the groups. The school administrations (e) were involved from the very beginning of the project, as their participation was based on their own decision and initiative. The schools' teaching staff (e) was involved from the very start to discuss the details of the project's implementation and development. A specific group of selected teachers worked closely with the project. These teachers were selected based on their willingness to participate, and, most importantly, on the subject matter they taught. Teachers were involved in the development of the project's tools and guidelines, as their opinions and suggestions were solicited from the beginning by the project developers. Teachers were also key in the implementation and evaluation process, as they worked closely with the project researchers in implementing both the guidelines and tools.

User-centred approach

For the design of GameLet, a user-centred methodology was chosen, based on a careful combination and integration of learning design (Gagne et al., 2005), UX-design (Hassenzahl, 2010), as well as approaches to Game-design (Salen and Zimmerman, 2003) and Gamification (Kapp, 2012). Corresponding design and development activities were pursued in a parallel and interwoven approach.

Regarding Usability and UX, state-of-the-art methods from Human-centred Design (ISO, 2019), Interaction Design (Sharp et al., 2019), and UX design (Hassenzahl, 2010) were applied to ensure the development of interfaces that are visually appealing, engaging, and easy to use. In a similar vein, several methods were included in the process: the design of Personas (Pruitt and Grudin, 2003) for improved consideration of students' different needs and expectations (e.g., for students with different skills levels and cultural backgrounds), Scenario-based Design (Rosson and Carroll, 2002) to support the design of learning and interaction on different levels of abstraction, Customer Journey Maps (Endmann and Keßner, 2016) for analysing individual learning and gaming paths in the system, low-fi prototyping with paper and dedicated prototyping tools (e.g., Axure), use of focus group meetings (Sharp et al., 2019) to discuss concepts and prototypes with stakeholders, as well as Usability testing (Krug, 2000) and expert reviews for formative evaluation of concepts and prototypes (Sharp et al., 2019).

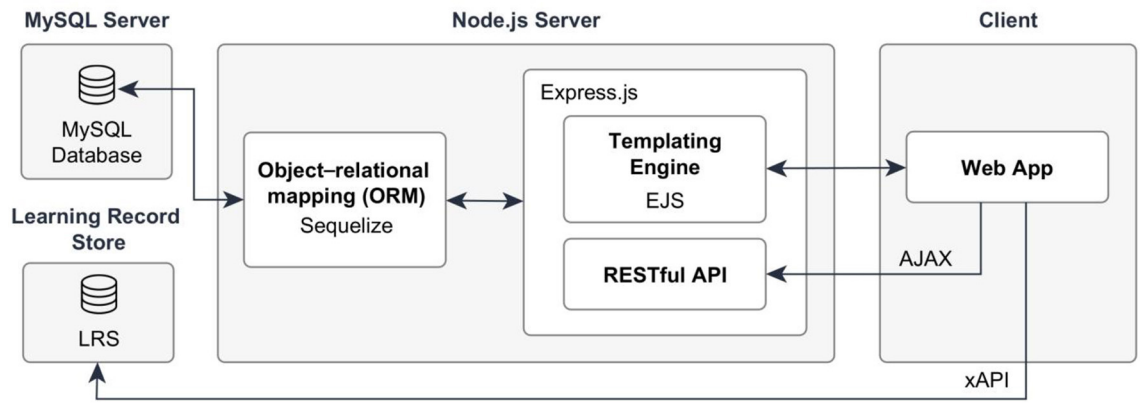

FIGURE 9
A top-level view of the software architecture.

Software function testing and learning, Usability, and UX concept testing were intricately interwoven, requiring short software development iteration cycles and constant development efforts. Software Engineering was guided by the principles of Agile Development (Schwaber, 2004; Sutherland, 2021), implying first and foremost, iterative development in short cycles and constant revision of goals. As such, established Game-design methods (Macklin and Sharp, 2016), including the selection and appropriate iterative adaptation of game mechanics (Sicart, 2008; Chou, 2014), low-fi prototyping with board games, and frequent play testing to balance learning and fun, were applied in parallel to and in combination with design methods from the mentioned fields. In the Gamification process, this led to an approach based on four central principles, concepts, and corresponding game mechanics: Meaningful narrative, Role-playing, Collaboration, and Production.

Formative evaluations

In the project, evaluation included the use of qualitative and quantitative indicators, and the quality of designed solutions was continuously monitored from an early stage with major assessments at the end of each iterative design cycle with respect to:

- Acceptance and Usability of designed solutions, including learning designs and sequencing of learning activities, assessed in terms of Usability tests, with supplementing questionnaires and semi-structured interviews.
- Functionality and reliability of software and media components when employed by real users, assessed in terms of unit and acceptance tests, where appropriate.
- Fun, flow, coherence of narrative and perception of gamified elements such as the paper game board, characters and learning tasks plus balancing their (meaningful) rewards, assessed in playtesting and co-design sessions supplemented by interviews.
- The time and materials required as well as the applicability of the GameLet learning programme in everyday school life and with respect to the curriculum were discussed after each trial in follow-up interviews with the teachers.
- User experience with a focus on the interplay of all components such as Moodle and the GameLet learning environment, the training process and its embedding in the narrative as well as the learning activities and their gamification.

Table 2 provides a more comprehensive overview on GameLet evaluations and methods used in the context of test trials.

The concrete application of these methods will be further explained in the context of the description of the GameLet development iterations.

It has to be mentioned that formative evaluations in the iterations were extremely hampered by COVID-19 related lockdowns of schools. Planned Usability tests, focus group meetings with students and playtesting rounds in presence with students and teachers at school could therefore not be realised in the planned scope or not be realised at all. Therefore, for a number of evaluations, student teachers from the partner universities had to be recruited instead for focus group meetings and Usability tests, and other planned evaluations were performed in terms of remote Usability tests, however with a reduced scope and number of test subjects, both from school and university contexts.

TABLE 2 GameLet test trials.

Aims and developments, playtesting and adaptations	Participants and research methods
Iteration 1–2019	
Gamified learning scenario • Narrative framework • Paper prototype of game environment, e.g. drawing the different areas on cardboard and elaborating on the connections among them, allocating learnings tasks + game elements • Examining the understanding of individual areas and tasks on the gameboard • Drawing the different areas on cardboard and elaborating on the connections among them • Carrying out a character design workshop and integrating further game mechanics **Gamification concept** • Game mechanics (e.g. rules, level structures) • Game environment **Recording studio** • Paper prototype	14 tests in sum; schools in Cyprus, Portugal, Germany **Participants** • 6–10 sixth and seventh-year students (depending on partner institutions) **Research methods** • Focus groups • Usability testing • Interview • Playtesting • Co-design sessions
Iteration 2–2020	
Gamified learning scenario • Single-game prototypes and activities • Revising narrative framework, e.g. making students protagonists **Gamification concept** • Improving Gamification concept (point system, etc.), Game-design session • Improving learning activities (e.g., *Emoji Tales*) **Recording studio** • Conceptualising and testing the digital implementation of the *Recording Studio* in several consecutive steps • Feedback functionalities	4 tests in schools **Participants** • 6–10 sixth and seventh year students **Research methods** • (Remote) Usability testing • Focus groups • Playtesting • Interviews • Co-design sessions
Iteration 3–2021	
• Testing a first flow through the whole GameLet environment • Testing the implementation of the whole gamified environment with the linear learning tasks step by step • Testing and critically reviewing of the results by stakeholders and experts	**Participants** in 5 online test rounds • GameLet researchers, teachers, students and student teachers Participants at 4 online focus-group meetings/discussions • 250 stakeholders and experts from outside the project, online **Research methods (all remote)** • Focus group discussions • Questionnaires • Observations of using GameLet environment • Interviews

Iterations

As is characteristic of DBR, the GameLet gamified learning scenario, the Gamification concept, the *Recording Studio* and the learning materials contained in it were developed together with the students and teachers in iterative cycles. The development of the prototypes followed an iterative cyclical process, in which the students and the teachers interacted with the developed materials. The prototype was refined step by step starting with low fidelity prototypes in paper form, moving on to click dummies and finally to the technical prototypes. Note that the iterations, methods and prototypes of DBR on the one hand, and the interim agile software developments and cycles on the other hand, are closely interdependent, but not identical.

In each iteration of the DBR-cycle, the overall concept continued to take shape and also became more differentiated. The project originally envisaged the learning environment and materials to be designed, tested, and redesigned in several successive iterative design and development cycles over 2 years. This phase was to be followed by a summative evaluation of all developments in the partner schools lasting about 6 months. In the first 18 months of the project, the products under development were tested regularly in one school in each of the three participating partner institutions with groups of 6 to 10 sixth and seventh-year students. From March 2020 onward, implementation was hampered by the COVID-19 pandemic. In particular, foreseen formative evaluations with students at schools could not be performed due to school access limitations. The project team reacted with a realignment for a complete online learning approach instead of the envisioned blended learning scenario and approaches to online evaluations. Still, the planned summative assessment which was envisaged to take 3–4 months could not be implemented.

To assure the reliability of test results across the partner institutions, tests were carefully designed and protocolled with detailed guidelines and instructions. Prior to each test, the researchers discussed the procedure *via* Skype. Each test was carried out by at least two researchers. Data was collected through observations, field notes, video recordings and informal interviews. Data was analysed and interpretations discussed within the respective research groups and the entire project team. Indicators to measure the quality of the development were, for example, to what extent learners could intuitively use the environment or whether they had difficulties and needed support. Furthermore, of interest was whether the tasks and the technical environment encouraged the learners to read their texts repeatedly, with either a real or a virtual partner. In addition, it was investigated whether the learners showed joy, displeasure or boredom during the completion of the tasks. Resulting insights were used to inform the design of the materials, which were then retested.

The results of these major evaluation rounds were incorporated into the final revision. In four Multiplier Events and in other dissemination events in Germany, Portugal, Cyprus and Switzerland, the final version was tested and critically reviewed. It was also discussed by stakeholders such as teacher trainers, university teachers and school administrators and teacher students from outside the project.

Iteratively improving GameLet: First iteration

The first iteration focussed on the narrative and Gamification frame, conducting co-design sessions with students. The intended function of the frame story was to foster students' identification with the learning activities and roles, and to help structure the learning. The podcast production theme also requires learning to cooperate within a team (Kutzelmann et al., 2017). Paper prototypes based on the first game idea were created, and evaluated in focus group meetings first with experts from the fields, i.e., RF experts, in later phases also with teachers and students. In the paper prototype used in the first iteration, game mechanics such as points scored, levels completed or skills mastered could also be adjusted *via* a paper status bar at the bottom of the paper game board. In the co-design sessions that were conducted, students expressed the desire to use the points collected in the game to dress their avatars and buy vehicles. This is an example of a participatory impulse that was later integrated into the Gamification concept as a shopping area to buy assets for the presentation of the podcast (see Figure 12). Experiences gathered in the first iteration helped to refine game mechanics, such as game rules and level structures. Most importantly, students liked the concept and were clearly motivated to use the system. The general game concepts were very well-received and understood, which led the researchers to increase the level of fidelity of the demonstrators, and to add levels of detail and depth to the preliminary first concepts.

In addition, essential character roles for the story were designed and evaluated based on role cards, ranging in their narrative functions from protagonist and antagonist to mentors and comic characters. Co-design workshops with students were conducted for character design, where students assigned an appearance, personality, behaviour and relationships of the protagonists involved. We initially expected stronger identification and emotional involvement of students with a story of two carefully designed artificial main characters. However, this idea was dropped based on feedback from students in co-design sessions, and we decided to make the students the main protagonists of the story themselves instead.

In iteration 1, the central learning scenario and learning processes were in the focus of development and evaluation, including RF training tasks and learner interactions (see Figure 10). Based on the framing story and paper prototypes, learning tasks were allocated to game elements (Massler et al., 2019). Designs were also frequently evaluated in focus group meetings with teachers and students.

During this, first formative assessments of initial prototypes of the game environment were conducted. Based on the framing story, a general learning scenario and game environment concept including game mechanics and elements were detailed (Massler et al., 2019). Paper prototypes were employed in focus group meetings first with experts from the fields, i.e., RF experts, later also with teachers and students. First versions of the prototypes were intended to be used as hybrid games in combination with a tablet. This approach allowed us to simulate the progress of the game flow based on the board game, situate RF tasks and test the players' interactions.

Within the scope of this article, it is not possible to provide a comprehensive description of all trials, but one test round is presented here as an example. In iteration 1, a paper prototype was used to test the first version of the *Recording Studio,* our most important tool for podcast creation, that is employed

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FIGURE 10
Researchers and students jointly designing and playtesting the game concept based on a paper prototype.

in GameLet in several variations. The interaction steps were simulated simultaneously by paper snippets.

This test focused on the core functionalities of the *Recording Studio*: Listen to a model recording, record and listen to your role, delete recordings and choose a favourite. In the Usability test, both quantitative data such as duration, clicks, success/dropout, and qualitative data (thinking aloud) were collected. Five students from a German school took part in this trial.

The tasks of the test were closely adapted to an authentic learning situation. Among others, the following aspects and tasks were evaluated:

1. Selecting of text excerpts and activating of model reading for the selected text.
2. Rehearsing and recording of an assigned role in a scene.
3. Reviewing a recording.
4. Review a number of recordings and select the poorest one for deletion.
5. Review a number of recordings and select the best one as the favourite for publication to group members.

Each development iteration was accompanied by several iterative Usability tests, starting with paper prototypes up to the technically implemented versions in the learning environment. Corresponding Usability tests were conducted strictly along the action guidelines in several partner schools.

Iteratively improving GameLet: Second iteration

During the second evaluation cycle, three interventions were carried out in the cooperating schools. Activities and mini-games were further developed and tested which would lead students through the different missions containing all the necessary learning steps to finish the podcast production successfully. The observations in this iteration confirmed that the devised learning activities and their structure succeeded in securing students' understanding of the RT story to be produced, its language and its content. They also seemed suitable in encouraging them to practise reading the role aloud with others and on their own and giving and receiving feedback on group members' reading aloud production. Above all, students were always very interested in improving their own performance and proud of their results at the end.

While the envisaged adventure game approach was revoked, feedback suggested that some sort of score based reward that was present in the initial board game concept should be preserved, because scores supported immediate orientation and assessment, and also engaged some students. Thus, during the second iteration, the challenge emerged to devise a score system that does not demotivate or change the focus of our storytelling and role-based approach to a competition game. The new concept was tested in iteration 3, cf. below.

In iteration 2, the *Recording Studio* was converted from a paper prototype to a digital web version (see Figure 11). This tool gave each student group the opportunity to record their podcast scene, so that in the end a jointly recorded podcast was created. The digital *Recording Studio* was investigated for Usability using a mixed methods approach. The same functionalities were inspected as described in iteration 1. In addition, feedback requests along with giving and receiving feedback were tested. In the web interface, students could view their text digitally and listen to model audio recordings. They could record their text sections several times, compare them with the model and select their best recording.

After adding improvements to the design, a digital version of the *Recording Studio* was implemented, showing good Usability from the beginning. Accordingly, at the end of iteration 2, the evaluative discussion rounds with the GameLet partners not only brought to light that the *Recording Studio* worked well and supported the RF training. More importantly, evaluations across partners unanimously showed that the learners made great efforts when recording their text passages, they gave sincere and open feedback to their classmates and also demanded it for their own recordings.

Iteratively improving GameLet: Third iteration

In iteration 3, the newly devised Gamification subsystem received a final balance. This included mission flow with all unlocking level mechanisms, possible repetition of some games and respective points earned by performance. More points were rewarded for the more impacting and difficult final stages, and the spending mechanisms of the gained points in the podcast shopping area were improved as well (see Figure 12).

In iteration 3, major formative evaluations were conducted to determine whether the GameLet training programme was working in its entirety. Further, the collaborative scenario of

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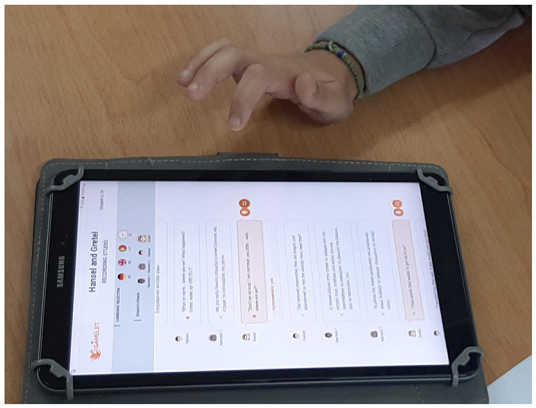

FIGURE 11
Student working with the digital version of the *Recording Studio*.

practising together was conceptualised and tested within the mission flow. For this purpose, the complete flow was tested along with measuring the time required for the entire walk-through GameLet from Mission 1 to 5. As in the previous iterations, the *Recording Studio* also played an important role in the evaluations of this iteration.

Conducted evaluations assessed whether the planned number of mini-games and exercises for RF and their repetition were motivating for the learners or whether they might be too numerous, too lengthy and therefore potentially demotivating. Since it became visible that the instructional concept included too many individual exercises and games for promoting RF, a decision was made to define a slim version that could be expanded as required and given the appropriate time contingent. Accordingly, the software was configured to allow teachers to lock and unlock tasks.

Evaluations also focused on the question of whether the existing instructions in video form provided by the characters of the director, the drama coach and the speech coach, were comprehensible and sufficient. The evaluation showed that there was a need to better guide students through the learning process. Accordingly, additional and improved video clips, e.g., providing task instructions or explanations from the director, were implemented in the system.

It was also assessed how often teachers could be expected to give feedback in relation to their workload and at which points in the learning process feedback from classmates or self-reflection would be required and efficient. Iteration 3 revealed that teachers could at most give feedback once to an individual learner and once to a group. However, peer feedback given by learners using the feedback form implemented was considered to be sufficient to support the learners in a meaningful way by teachers. Teachers particularly appreciated the possibility of using GameLet's individualised, (semi-)automatic feedback possibilities, which allowed them to help individual learners while others were working independently.

In the following, we exemplify one selected approach to evaluation in this iteration in greater detail. In the context of a more comprehensive trial, an evaluation with teachers was intended. Due to COVID-19 and corresponding difficulties in acquiring in-service teachers, the evaluation was performed with teacher students and in remote settings instead, a mixed survey design was applied including individual experimentation and playtesting rounds with observation, individual feedback questionnaires, individual feedback sessions, and a final focus group discussion. Furthermore, findings were later discussed in plenary with all participants, and conclusions for further improvement of the learning environment were drawn jointly.

Results

The development process resulted in a functional prototype of the GameLet concept integrating the presented instructional and Gamification approaches. The prototype also considered the comprehensive feedback from formative evaluations and resulting design decisions from the iterations described in the previous chapter. The envisaged development process contained a comprehensive summative evaluation, including trials with students at schools. However, due to COVID-19 forced school lockdowns, such an evaluation could not be implemented to date.

Still, the various formative evaluations from the three DBR iterations provide meaningful results overall. Some of these results have already been briefly presented in Section Iterations to illustrate the iterations and general procedure to integrate feedback into the design process. In the following, we provide a more comprehensive description of general results from these evaluations.

GameLet at its core provides a digital tool to perform MELT online, the *Recording Studio*. That is, GameLet allows for RT-based activities with multilingual content in a fully virtual environment. A good reference for this are the user tests conducted for the *Recording Studio* (see above chapter on iterations). Results clearly show that students are encouraged to use the functionalities of the application for training. All formative evaluations, especially user tests with students and feedback from focus groups with teachers, indicated that the mapping of MELT to the digital domain was successful and the provided tools were well-accepted for collaborative RT activities without perceived deficits by all stakeholders.

Functionalities provided in terms of the *Recording Studio*, which allows for individual and group rehearsal as well as model reading on demand, were also well-accepted and considered a valuable enhancement. The *Recording Studio* proved to be a very flexible and powerful element in GameLet, allowing for a wide range of learning activities in the course of the GameLet

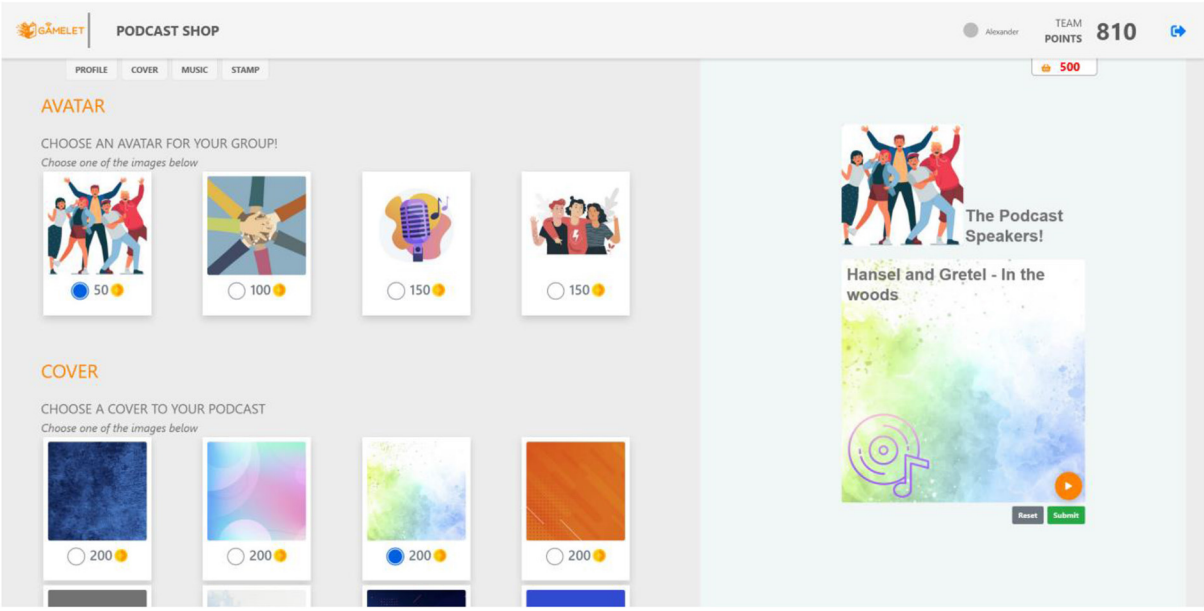

FIGURE 12
Shopping area that allows students to personalise the presentation of their podcast and actors.

training. In all of these scenarios, the final versions of the *Recording Studio* depicted no larger problems in Usability tests and were attributed to good user experience in interviews and focus group feedback.

From the very beginning, formative evaluations indicated that the GameLet approach motivates students to perform self-guided learning activities, both within collaborative settings and individual learning. From this we conclude that the principle GameLet approach of adapting MELT with appropriate Gamification rendered successful. We attribute this in particular to the specific approach of Meaningful Gamification taken in GameLet, facilitating motivation of students and fostering acceptance of learning activities. Students showed increased motivation to perform tasks related to individual learning and learning in scenarios that we foresee as potentially relevant in context of learning at home and seamless learning in general. Teachers supervising the student groups reported in feedback sessions that the students were very interested in working with the GameLet environment beyond the trials.

As such, we conclude tentatively that the principle project objective to design a learning environment for RF training that motivates students to work alone or in groups in self-guided activities, has been achieved, well-understanding that a more comprehensive summative evaluation should be performed to further support this claim. This interpretation is also supported by results from the Usability test described in the results section Observations revealed high motivation and fun in students performing tasks on their own in GameLet, especially with regard to the main tasks of reading aloud and recording their turns. For instance, one student stated with respect to the question "What was especially great?": "Seeing how you become more convincing with every recording."

A specific finding in the context of the Gamification design was that students preferred a story and scenarios allowing them to act as real podcast speakers to one where they took the role of mere advisor to virtual main characters that advance the story, as an initial design concept envisaged that was later rejected. This appears to be well in line with findings from related fields that more comprehensive and meaningful forms of interactivity foster participation (Salen and Zimmerman, 2003), and, at the very end, learning (Woo and Reeves, 2007). Extensive co-design sessions were conducted in all three partner countries to develop a meaningful and relevant story with expressive characters for the students. The high enthusiasm in this participatory task indicates a high level of interest in integrating narrative elements into a gamified learning environment.

As mentioned above, while Meaningful Gamification represents the core approach to student motivation in GameLet, some elements of reward-based Gamification were added by demand of students in participatory design sessions, for instance related to the introduction of a shopping area (see Figure 12). In the design process, special care was taken to ensure that points were awarded for performances closely related to the goal of the missions. Still, we observed that for a number of students, these reward-based elements represented an additional source of motivation within their group to work with GameLet.

Formative evaluations provided evidence that the careful introduction of reward-based elements did not hamper the general Meaningful Gamification approach. We observed that students still perceived the GameLet missions as most important, and prioritised corresponding activities when working in GameLet. From this we conclude that a combination of Meaningful Gamification with Reward-based Gamification elements is in principle possible, when an integration of the latter is pursued carefully and when these do not distract too much from the main story and activities.

Focus group meetings with teachers revealed a very positive assessment of GameLet learning activities and exercises, and GameLet was considered effective for fostering RF in practical application. Teachers assessed that tasks build on each other well, correspond to the different approaches to text understanding and support different learner types. In addition, GameLet was perceived as a novel and enhanced method to provide feedback to individual training activities of students, for instance based on reviewing recordings of individual students and by assessing those. Feedback sessions after each trial showed that students felt more confident in reading aloud after training; they were very motivated to keep on recording their roles until they were entirely satisfied; they were very enthusiastic when asked to explain what they had been doing. However, the actual time spent on RF training in the context of the formative evaluations was too short to allow for detecting a measurable impact.

Overall, all formative evaluations provided evidence that GameLet provides a convincing Usability as well as user and learning experience. Especially in the formative Usability and user experience evaluations in the last iteration, no major problems regarding the workflow in learning processes and activities were found, requiring rectifications mainly on the level of the graphical user interface (GUI), interactions and task descriptions.

While an additional comprehensive summative evaluation could not be implemented, qualitative feedback rounds in the context of focus group meetings with in-service teachers in several countries revealed positive general assessments of the GameLet approach and toolset. Participants expressed a high level of acceptance and motivation to apply GameLet in their own classrooms (87.5% in a first and 100% in a second evaluation with teachers in Germany and Switzerland). One teacher expressed: "The topic of Gamification was very exciting and was explained well. The "GameLet" project is also extremely appealing. It made me want to implement it in my own class." In addition, teacher feedback also indicated that the GameLet trials positively impacted their perception of the importance of RF and the options Gamification concepts offer.

Overall, we consider the integration of teachers and students as extremely helpful and a key factor to the success of the GameLet design process. Co-design sessions opened up opportunities to develop ideas for and together with the target group. In addition, these sessions allowed for immediate testing of concepts and provided extremely helpful feedback.

Discussion

GameLet has successfully shown how an iterative design process with several formative evaluation iterations can coordinate innovation and development in Gamification, instructional design, software development, and UX/UI-design to foster RF. It led to a system that supports seamless learning and was very well-received in evaluations. The iterative production of increasingly complex artefacts that address all of these aspects during the project has shown to be a key to success. Due to the pandemic, the long-term effects of the use of GameLet in the classroom could not be explored. However, teachers' and students' reactions during the trials and at the multiplier events point not only to a high acceptance of the learning environment and its materials, but also to their motivational benefits for the training of RF.

An important result of GameLet refers to the Gamification concept. One decisive step was to enclose the initial narrative that was already inherent in RT within another role playing layer, i.e., by the story that motivates the different missions and that keeps alive the reference to the final goal of jointly developing a podcast. All activities are structured and motivated by this framing narrative. The GameLet approach thus continuously exposes students to the specific usefulness—"meaning"—of acquiring reading competency: If they learn to read aloud, they can create audiobooks and podcasts, and by extension read the news and do theatre. Role-playing in the context of a structured story is an essential element that elucidates how this specific competency is instrumental towards certain goals, e.g., students can only be a speaker in an audio production if they master reading aloud. GameLet stresses even more the instrumental aspects of the learning goals by defining a subject area specific product (the podcast) as the final goal of the learning journey. "Play" aspects counterbalance the demonstration of instrumentality to students: What students learn is not only useful for them to achieve goals, but they can also enjoy doing and learning it for its own sake. "Play" enables the students to explore what could be attractive and exciting within the subject taught. In GameLet, the exploration inherent in speaking and recording parts of a script already entails considerable "play" moments.

Because "Meaningful" Gamification mechanics and tools are more domain specific than points and badges, providing precise transfer guidelines of GameLet's Gamification concepts to other domains is an open quest at this moment. A future, comprehensive transfer strategy will have to address the following questions:

- What is the specific competency of the domain good for and how can we create a story and role-playing that enables the students to experience this usefulness?
- What is the mission or product that defines the final goal of the learning journey?
- What is intrinsically enjoyable in the specific subject field and how can paratelic "playing" activities be incorporated into the learning process?
- What is useful and enjoyable when it comes to the mechanics of collaboration between students in this specific subject area, and what are the domain specific feedback patterns (for example, "you are reading too fast" is a domain specific feedback in RF)?
- How can digital tools (e.g., specific tools for feedback, for content creation, for simulation, for collaboration) be created that will help structure the learning process and apply the principles mentioned above?

In fact, some important insights and concepts of GameLet are not intrinsically digital, such as for example the concept of an embracing narrative that guides through the learning process. But the provision of dedicated software tools entails invaluable benefits, such as efficiency for learners and teachers, easy to employ in class, facilitation of collaboration, providing remote feedback, structure and guidance in using correct categories and tools (such as correct annotations), self-assessment (for example by hearing the own recorded voice, and its progress through the learning process), enabling joint production (recording), and also by creating a coherent, agreeable, gamelike user interaction experience throughout the learning process.

The GameLet system can also inspire and serve as the basis for numerous variations of core concepts. While in the development process the decision was made to abstain from a story design with two virtual main characters who thrive to overcome all obstacles on their road to becoming successful podcast speakers, in favour of students playing themselves as the main protagonists, this alternative design strategy may provide the potential of other novel gamified RF training experiences. For instance, other types of more classical RF learning games (e.g., in terms of adventure games) may be contemplated, or specifically designed toys for children to play with at home, where they prepare performances that they could perform in front of adults. Schneider (2020) has developed such concepts of storytelling toys that motivate children to read aloud at home in the context of a home performance, based on a single tablet. Similarly, speech assistants can provide an interesting modification. For instance, a speech assistant such as Amazon Alexa can function as a virtual tutor or learning partner in a home setting. This approach has been explored by Durski et al. (2020) in the context of GameLet.

Summary and future work

GameLet created an integrated learning environment that promotes the acquisition of RF skills in school education. The system integrates Meaningful Gamification, ICT, instructional methods and structures, narration and role-playing, seamless, group and individual learning, and learning materials, including multilingual resources. GameLet combines individualisation of training with independent and self-directed learning, as well as collaboration and guided peer-feedback. GameLet fosters fun and motivation. It is attractive to students as a whole, from visual design and user experience of the digital media and the joy of role-playing in a gamified environment to a meaningful and satisfying learning experience. For a teacher, GameLet combines important personal and professional aspects: gamifying an ostensibly boring learning task, that of reading aloud, in a computer and web-based environment in a best practise example of educational innovation which effectively meets a real teaching need and offers plenty of additional learning opportunities. It demonstrates how an iterative, design-based process can gradually lead to such an integrated learning system. Intermediary evaluation results and expert feedback were excellent. GameLet provides a foundation for rethinking similar complex development challenges and reconsidering how ICT and media can be used in school education. Additionally, it provides for differentiation.

Since a final summative evaluation could not be conducted due to the COVID-pandemic, the project team will conduct a pilot study with selected teachers in cooperation with the Baden-Württemberg Centre for School Quality and Teacher Education in autumn 2022/23 in preparation for a long-term study which is to be conducted in 23–24. Furthermore, the Ministry of Education in Cyprus would like to offer teacher training on gamified, media-based support for reading fluency in the future.

Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding author/s.

Ethics statement

Ethical review and approval was not required for the study on human participants in accordance with the local legislation and institutional requirements. Written informed consent to participate in this study was provided by the participants' legal guardian/next of kin. Written informed consent was obtained from the individual(s), and minor(s)' legal guardian/next of kin, for the publication of any potentially identifiable images or data included in this article.

Author contributions

All authors listed have made a substantial, direct, and intellectual contribution to the work and approved it for publication.

Funding

GameLet: Gamified, media-based training of reading fluency. The project was sponsored by the European Union through the programme ERASMUS+ Strategic Partnerships. Grant Number VG-IN-BW-18-36-047464.

With the support of the Erasmus+ Programme of the European Union

Acknowledgments

The authors would like to express their sincere gratitude to the schools that participated and greatly contributed to GameLet, to the numerous students and student helpers, and to all the wonderful support and contribution of many others that cannot be mentioned here by name. Without all of them, GameLet would not have been possible.

Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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