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A Qualitative Evaluation Study of Introducing Game-Based

Learning Methods during Pre-Service Teachers' Internship.

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Abstract

This study presents the results of a qualitative evaluation of how pre-service teachers incorporate games into their classroom practices during internships. Two Game-Based Learning (GBL) methods, namely the PCaRD model and the GameChangers approach, were introduced to assist pre-service teachers in delivering game-based learning activities effectively within disciplines such as English and Sports, as part of their university course requirements. Data was collected from 48 pre-service teachers, highlighting the perceived benefits of both methods in teaching with games and emphasizing their complementarity. Essential competencies identified included prior gaming experience, training in game creation, digital skills, and understanding of student behavior and reactions. Main challenges encountered included time constraints, classroom equipment deficiencies, class management issues, pupil behavior, and aligning games with the curriculum.

1. Introduction

This study addresses an important but understudied challenge (Hanghøj & Engel Brund, 2010; Molin, 2017; Foster & Shah, 2020; Mohanty et al., 2021; Hu & Sperling, 2022; Rüth et al., 2022) within the field of Game-Based Learning (GBL), namely how pre-service teachers incorporate and evaluate games in a real classroom setting. In the literature, two similar terms refer to the integration of games into educational settings to enhance the learning experience: game-based learning (GBL) and game-based pedagogy (GBP).

Nousiainen et al. (2015) identified four different game-based approaches within GBP: using educational games, using entertainment games, learning by making games, and gamification (or applying game design and game principles to non-game contexts). A slightly different connotation of GBP is used in the French scientific literature: la ludopédagogie, which is also derived from the Latin word ludo (meaning rules-oriented game) and the French word pédagogie, which means pedagogy. Alvarez (2018, p. 29) described la ludopédagogie as "the idea of using a game as a pedagogical approach" In a more extended definition, Lépinard and Vandangeon-Derumez (2019, p. 5) define it as "all game-based activities implemented by a teacher with the goal of supporting learning processes in both formal and non-formal pedagogical contexts."

Wiggins (2016) prefers the term GBL over GBP and defines it as "the intentional use of digital or non-digital games or simulations for the purpose of fulfilling one or more specific learning objectives" (p.19). When looking at recent meta-analyses (Krath et al., 2021; Soo & Lee, 2022; Sun et al., 2023), almost exclusively, the term GBL, referring to the broader concept of using games as a tool for facilitating learning, is used.

Studying how teachers facilitate educational games, various scholars (Hanghøj & Engel Brund, 2010; Molin, 2017; Foster & Shah, 2020; Mohanty et al., 2021; Rüth et al., 2022) noted a lack of empirical evidence regarding the pedagogical choices and considerations teachers make when deciding to integrate games into their teaching practice. Within their meta-review, Krath et al. (2021) identified 118 distinct theories used to clarify the influence of gamification, serious games (games designed with a range of serious

intentions), and GBL on emotions, motivation, behavior, and learning outcomes across various contexts. However, to translate these insights into practical application, they indicate that educators "need to develop competencies regarding the underlying theoretical foundations and their principal commonalities" (p.15).

In their qualitative review of the literature on the teachers' roles and activities when using games in education, Kangas et al. (2017) found that teachers' actions and processes during the whole learning activity remain unstudied. Recent research (Lai et al., 2020; Howard, 2023) dives even deeper, aiming to comprehend how the interaction between teachers and gamification software mold their professional identities within distinct contexts.

Despite research highlighting the pedagogical benefits of game-based learning, the integration of games into teacher training is a neglected topic. Pre-service and in-service teachers alike should be given the opportunities to develop their competencies in game-based learning, but GBL teacher education is still in its infancy (Li, 2013; Foster et al., 2016; Molin, 2017; Foster & Shah, 2020; Hu & Sperling, 2022).

According to Ehrich and Millwater (2011), internships play an important role in teacher education and are commonly utilized across various fields to facilitate the orientation and integration of newcomers into specific career trajectories. The nature of these internships varies depending on factors such as the national context and cultural influences. The internship discussed within this study concerns a period of professional immersion in a school environment, allowing pre-service teachers to acquire concrete pedagogical

and didactic skills for their future teaching career. The year-long Master 2 program is structured with one-third dedicated to teaching responsibilities during the internship and two-thirds focused on university training. This detail is particularly relevant as the article explores the evaluation of GBL within a specific internship setting.

2. Theoretical background

2.1. The teacher and GBL

In their TAM-based study, Bourgonjon et al. (2013) reported that teachers are convinced that games (video games in this study) are useful in their teaching practice, but less certain whether they enhance their teaching performance. In this context, the authors assumed that games adapted to the curriculum, such as multi-user virtual environments, were more likely to be used. Several years later, Kaimara et al. (2021) identified this missing link with the curriculum as one of the five barriers that pre-service teachers believe will prevent them from implementing digital game-based learning. Four additional barriers were mentioned: a lack of financial resources, a preference for teaching with traditional methods, a lack of infrastructure, and limited training opportunities. In their study on the adoption of gamification, Sánchez-Mena and Martí-Parreño (2017) identified the pupils' apathy for the course subject and teachers' fear of disrupting classroom dynamics as possible obstacles, but they also highlighted drivers such as the pupils' motivation, interactive and active learning, and ease of learning with games. Given the extensive research into barriers surrounding game integration (Sánchez-Mena & Martí-Parreño, 2017; Nikolopoulou, 2020; Kaimara et al., 2021; Hu & Sperling, 2022; Rüth et al., 2022; Pozo et al., 2022), several scholars (Hébert et al., 2021; Pozo et al.,

2022; Hayak & Avidov-Ungar, 2023) underscore the importance of providing pre-service teachers with an understanding of these barriers and drivers to emphasize the benefits of using games, to inform them about the support this requires within the classroom, and to eliminate the uncertainty teachers may have (Foster et al., 2016) about their ability to incorporate games in their future teaching.

Besides the numerous studies highlighting how teachers' attitudes and a wide range of barriers and drivers influence game-based learning, several researchers (Hanghøj & Engel Brund, 2010; Becker, 2017; Molin, 2017; Jääskä & Aaltonen, 2022) drew attention to another important component of game-based learning: the shifting roles teachers play when using GBL, and the various ways in which they need to respond to multiple demands and situations in an educational setting, should not be underestimated. Or, as formulated by Hanghøj and Engel Brund (2010), "teachers' roles should not be seen as fixed 'scripts' or functions, but rather understood as more or less stable patterns of interaction and expectations that are based upon processes of continual negotiation – i.e., between a teacher, a game scenario, and their students" (p.117). According to Hanghøj (2013), teachers assume four roles when using games for educational purposes: instructor (by relating the game to learning objectives and the curriculum), playmaker (to establish a play scenario), guide (to scaffold the learning during play), and evaluator (to evaluate and discuss). The qualitative literature review by Kangas et al. (2017) confirms the importance of the teacher's role. Their review motivated the authors to categorize the processes occurring in the classroom into four categories: planning (create a pedagogical framework and game-based learning processes),

orientation (start the game-based learning process and explore the subject), playing (frame the learning during play), and elaboration (debriefing after the game). The same findings were reported by several researchers, including Tzuo et al. (2012), Molin (2017), Foster & Shah (2020) and Pozo et al., 2022. They stressed the need for teachers to observe students' engagement and immersion, scaffold the learning during the game, align the game experience with other learning experiences, and provide students with metacognitive guidance.

Besides the factors that influence a teacher's decision to adopt games, and the different roles that teachers assume, several authors (Kangas et al., 2017; Nousiainen et al., 2018; Arifudin et al., 2020; Tay et al., 2022) have suggested that pedagogical models are vital for the successful implementation of GBL.

2.2. Pedagogical models

Researchers have proposed various pedagogical models to guide (digital) game development, including the ARCS model (Attention, Relevance, Confidence, and Satisfaction) (Keller, 1987; Li & Keller, 2018), the MDA Framework (Mechanics, Dynamics, and Aesthetics) (Hunicke et al., 2004; Kusuma et al., 2018), the TPaCK Model (Technological Pedagogical Content Knowledge) (Mishra & Koehler, 2006; Foster et al., 2011), Gee's Learning Principles (Gee, 2003), and Winn's DPE framework (Design-Play-Experience) (Winn, 2009). Laine and Lindberg (2020) conducted a systematic literature review and established a taxonomy of 56 game motivators and 54 educational game design principles, interconnecting these elements. Additionally, Tay et al. (2022) enumerated diverse pedagogical frameworks and teaching strategies integrated into GBL design for adult learners. Chen et al. (2020) investigated the essential

literacies needed for successful GBL implementation, identifying four key areas for teacher training: aligning game design with learning objectives (instructional design literacy), understanding teachers' attitudes and their impact on student motivation and learning outcomes (evaluation literacy), selecting engaging games and understanding core concepts (basic games literacy), and overcoming technological and logistical barriers (organization and management literacy). Particularly, the latter was considered crucial for novice teachers.

In their review of game-based learning in teacher education (from 2007 to 2018), Foster & Shah (2020) found that both pre-service and in-service teachers benefit from courses that support their professional development, especially in learning how to use games in teaching. Maratou et al. (2023) discussed how a game-based approach also enhances generic teaching skills of educators, especially their creativity, flexibility, and ability to assess pupils' behavior while fostering closer pupil relationships. Additionally, they highlight not only the improvement in teaching, but also stress the organizational and management skills that are required to effectively implement game-based learning interventions.

A more comprehensive study by Rulyansah et al. (2023) expands on this by identifying 10 essential teacher competencies required to implement game-based learning (GBL), categorized into four primary areas: pedagogy, technology, collaboration, and creativity. According to the authors, pedagogical skills include curriculum construction, tutoring, and assessing student competence. Technology expertise involves analyzing digital games and overcoming tech-related obstacles. Collaborative skills encompass both in-

school and external interactions. Creative abilities focus on playfulness, exploration, improvisation, and personal development.

In-service teachers are encouraged to proactively acquire such knowledge by engaging in peer discussions, reading relevant literature, and naturally experimenting with their teaching methodologies to discern effective strategies from ineffective ones (Ward et al., 2018). Noted by Foster & Shah (2020), given current trends in policies and survey reports regarding digital games, it appears to be an ideal time for teacher education programs and researchers to respond to teachers' interest in integrating games into their teaching practices.

Considering this need and the diversity of pedagogical models and approaches available for guiding the development of games, this study aims to refine the approach by specifically focusing on two prominent approaches: The PCaRD model and the GameChangers approach. The selection of the initial approaches is based on two distinct rationales. The first approach, the PCaRD model, was chosen because pre-service teachers had already been introduced to the TPaCK model in a previous course (Master 1) with the same instructors. TPaCK served as the foundation for justifying their choices during ICT lessons, so it was important to integrate a GBL approach that built upon those principles. The second approach, the GameChangers approach, was chosen due to the researchers' institutional affiliation with the approach's creator.

2.2.1. PCaRD

Foster (2012) and Foster and Shah (2012, 2015) introduced the Game Network Analysis (GaNA) as a two-step method to enhance teachers' competencies in game-based learning. Initially, teachers analyze games and decide on their

implementation, utilizing Aarseth's (2003) three methods for understanding

game content: analyzing mechanics and design, observing gameplay, and

playing the game firsthand. A more comprehensive illustration is available in

Foster et al.'s (2011) article. Teachers can then integrate games into their

teaching practice by adopting multiple pedagogical roles (such as those

described by Hanghøj, 2013) in both formal and informal learning

environments.

The GaNA framework incorporates several models (Foster et al., 2016),

including the ICCE (Inquiry, Communication, Construction and Expression)

model based on Dewey (1906) and Bruce et al. (1997), the TPaCK

(Technological Pedagogical Content Knowledge) model by Mishra and

Koehler (2006), and the PCaRD (Play Curricular Activity Reflection

Discussion) model by Foster and Shah (2012, 2015). The ICCE model supports

the analysis of game components (Shah & Foster, 2014), while the TPaCK

model analyzes games in terms of their technological, pedagogical, or content

affordances.

The TPaCK model (Mishra & Koehler, 2006) identifies three types of

knowledge (content, pedagogy, and technology) that teachers must integrate

for successful technology implementation. This mechanism applies to the

integration of games. Identifying the technical features, pedagogical strategies

and embedded content within a game is often overlooked (Foster et al., 2011).

As a result, TPaCK allows teachers "to treat the game as a curriculum" (Foster,

2012, p. 204). Using these insights, Foster and Shah (2012, 2015) created the

PCaRD model, rooted in Engeström et al.'s (1999) Activity Theory and Gros's

(2007) learning environment approach. PCaRD enhances Gros's method by

incorporating Dewey's four components (1906), which are viewed as key impulses for learning. In this philosophy, students connect real-life experiences with school subjects through inquiry, construction, communication, and expression (ICEE). In Dewey's view, these elements form the curriculum rather than the traditional disciplines.

According to Foster (personal communication, November 21, 2022), teachers who lack time to analyze games in advance, can immediately start working with PCaRD. Although named PCaRD (Play, Curriculum, Reflection, and Discussion) for semantic reasons, each of its four phases is a curricular activity since every phase takes place in the classroom. Each phase of the PCaRD model clearly describes the *Objectives* achieved within that phase, the expected *Teacher Roles* and a *Demonstration of Learning*.

As outlined by Foster (2012), the main goal of the *Play phase* is to guide the gameplay process. The role of the teacher in this process is to provide pupils with natural and fun play opportunities (Pappert, 1997; Hsu & Chiou, 2011), create a naturalistic learning environment, and observe the games. In the *Curricular Activity phase*, the teacher leads the instructional activity by creating games to bridge the personal knowledge with school knowledge. During this phase, learning is demonstrated as a transfer from play. During the *Reflection phase*, pupils can reflect on the game they played, its design, or the problems they encountered, and the role of the teacher is to guide them through this process. *The Discussion phase* aims to tie everything together. The teacher scaffolds, facilitates, and guides discussions.

2.2.2. GameChangers

In response to colleagues seeking assistance with gamifying their courses, Arnab et al. (2017) developed the GameChangers program (GameChangers, n.d.), taking a unique approach that emphasizes the application of game design thinking and utilizes activity-based methods (Arnab et al., 2019). The aim of this approach is to enable game designers in educational contexts to maintain the wide perspective that learning processes require, while scaffolding the design process in a coherent and pedagogically sound manner (Arnab & Clarke, 2017). It proposes an open practice to reduce barriers to game design, particularly for practitioners unfamiliar with games (Arnab, 2020).

Initially, the GameChangers course was a gamified six-week program, with weekly stages (Arnab et al., 2017). The course has now evolved to include other game design thinking approaches. "Remixing Play" for example focuses on repurposing existing game ideas to design new educational games and has been adopted in various countries, such as Malaysia, where it was included in a pre-service teacher training program (Mohamad et al., 2019). The GameChangers program has since become a global movement for game-based learning (GameChangers, 2022), featuring several games and open educational resources (such as design guidelines and templates), all available for download under a Creative Commons license.

3. The aim

In line with recent research (Molin, 2017; Foster & Shah, 2020; Mohanty et al., 2021; Hu & Sperling, 2022; Rüth et al., 2022), integrating courses on game design, game literacy, and the integration of games into an educational framework should be a fundamental component of teacher education. Given

the development of courses aimed at assisting pre-service teachers in integrating games, this paper seeks to implement two GBL methods into pedagogical activities relevant to the faculty's teaching practice and subsequently evaluate the efficacy of these methods. This study addresses two main areas of inquiry: the pre-service teachers' feedback on the two GBL models they used to implement games, and the perceived competencies and constraints they encountered during the implementation. The following guiding questions were addressed:

How do pre-service teachers evaluate the PCaRD model and the GameChangers approach? Do they perceive them as tools aiding in the successful implementation of game-based learning?

What specific skills do they need, in addition to those they already possess, to implement games into their teaching practice? What were the other constraints they faced during the implementation of games?

4. Method

An empirically based qualitative evaluation study was conducted as part of a university course focusing on games. During their internship, pre-service teachers were invited to create or adapt a game relevant to their disciplines. Data were collected through a mandatory course assessment questionnaire with open-ended questions.

4.1. Participants

The setting for this research was the teaching department, Institut national supérieur du professorat et de l'éducation (Inspé) or National Institute of Education, of Université Côte d'Azur in Nice, France. For the 2019-2020

academic year, 62,600 pre-service teachers were enrolled in the National Institutes of Education located in 30 different universities in France and overseas (Marlat et al., 2020). The teacher department of Université Côte d'Azur is one of those 30 universities. It accounted for 2% of the total number of pre-service teachers in France during the 2019-2020 academic year and trains on average 3% of the total number of pre-service teachers.

During the 2019-2020 academic year, two cohorts of master's degree students, one preparing to teach English as a second language and the other physical education in secondary school, enrolled in a course on implementing games in secondary education. These pre-service teachers were in their final year of university, and the majority planned to begin as full-time in-service teachers the following school year.

In total, 18 pre-service English teachers (15 female and 3 male teachers) and 30 pre-service sports teachers (8 female and 22 male teachers) participated. Among them, 48% were women, which is not typical for the secondary education context in France, where 58.4% of all teachers are women (Le ministère de l'éducation nationale et de la jeunesse, 2019). As of the 2017-2018 school year, 85.3% of language teachers and 40.65% of sports teacher were women. Regarding pre-service teachers, Marlat et al. (2020) reported that, on average, 72% of all pre-service teachers in France are women.

4.2. Internship

The internships of French pre-service teachers were regulated by the decree (JORF) of August 22, 2014, and the professional competency framework for teaching and education professions by the decree (JORF) of July 1, 2013.

Within this framework, fourteen common competencies are defined for all teachers and education staff. Examples include: sharing the values of the Republic (no. 1), integrating elements of digital culture necessary for the exercise of one's profession (no. 9), cooperating within a team (no. 10), and participating in individual and collective professional development (no. 14). Our GBL course emphasizes the ninth competence, focusing on leveraging digital tools and methods for personalized and collaborative learning.

The cohort in this study had a unique status: they were both students at the faculty and in-service teachers in regular school settings. They had passed the state examination and were compensated as probationary civil servants. However, this dual status arrangement ceased from the academic year 2022-2023 onward. We will continue to refer to them as pre-service teachers as it best describes their situation. Unlike in many other teacher training programs, these pre-service teachers taught autonomously without direct supervision from an in-service teacher or supervisor. Therefore, they cannot be compared with pre-service teachers conducting their first teaching efforts during an internship.

4.3. University course

Table 1

The course's workflow linked to steps withing the GBL methods used

[insert Table 1.]

Pre-service teachers followed a course on the integration of games before and during their internship in a secondary school. The university course consisted of four three-hour sessions (two in late autumn and two in early spring).

Table 1 shows the course workflow linked to the different steps in PCaRD and GameChangers. During the first course, pre-service teachers were introduced to the Game Network Analysis (GaNA) framework, the PCaRD model, and the GameChangers approach. All pre-service teachers were already familiar with the TPaCK-model as it was part of the curriculum of this master's program the year before. Both GBL methods were discussed from a theoretical perspective. The PCaRD model was experienced from the teacher and the learner's perspective, and all phases (playing a game, observing gameplay, reflection, discussion, etc.) of the model were demonstrated during this first session.

During the second course, we mainly focused on the GameChangers approach. The original program contained weekly stages called *Missions*, and sub-tasks called *Quests* (Arnab et al., 2017). Participants could keep track of their iterative design process through scaffolded activities. A total of six missions needed to be completed: mission 1 (exploration and conceptualization of existing games and experiences), mission 2 (structure, design, reflection, and playtesting), mission 3 (prototyping and technological implementation), mission 4 (consolidation phase), mission 5 (pitch and iterative refinement), and mission 6 (possibility to pitch to a broader audience). Our pre-service teachers played games like "*What's your story?*" (GameChangers, 2022) and then created their own version of the game. In the third session, they were invited to create a game from scratch. During the last session, they shared their experience with their peers about the game played during their internship. They gave mutual feedback and discussed possible improvements.

Regarding the choice of GBL methods proposed, a previous version of this course had only presented the GaNA framework. At the end of the course, the

pre-service teachers concluded that they needed more information to gain a deeper understanding of games, they also wanted to create games from scratch or modify existing games. As a result, the GameChangers approach was added to the course.

4.4. Interview instrument and procedure

As the questionnaire also served as an assessment for the course, not all multi-level open-ended questions were relevant to this research. The questions cover a wide range of aspects related to the integration of games in the pre-service teachers' teaching practice. They address areas such as game selection, teacher competencies, collaboration, assessment, and alignment with curriculum objectives. These aim to provide a comprehensive understanding of the challenges and benefits associated with incorporating games, from both practical and theoretical perspectives. They facilitate reflection on the implementation process, the impact on pupil learning outcomes, and the role of GBL in teaching.

Our pre-service teachers had five months to integrate a game during their internship before submitting the questionnaire through an online drop box on the Moodle platform. The questionnaire was available in two languages; the English version was mandatory for the language pre-service teachers.

All participants provided their informed consent for the anonymized analysis of the data.

4.5. Data and analysis

For the coding phase of the analysis, the author was assisted by a bilingual psychology student (proficient in English and French) who had received

training in game theory and coding procedures. A pre-defined coding scheme, aligned with the research questions, guided the analysis.

NVivo 12 was used to facilitate the qualitative analysis of the data. Initially, both coders familiarized themselves with the data by reading all the questionnaires (phase 1). Subsequently, a thematic analysis was conducted to identify recurring patterns of meaning (Braun & Clarke, 2006) and to refine the coding scheme. To augment the coding scheme, ten randomly selected questionnaires were analyzed to capture key content and generate additional codes (phase 2). In a third phase, codebooks and themes were refined, and disagreements resolved after discussion (phase 3). In a second iteration, all questionnaires were analyzed. When necessary, the coders reached consensus on the selection of meaningful sentences or paragraphs (phase 4). The final phase, which involved producing the report, was handled exclusively by the author of this study (phase 5).

NVivo 12 Coder Comparison Queries were used to calculate Cohen's Kappa (or the interrater reliability) and the percentage of agreement between the two coders. There was a very high level of agreement between the coders (98.43%), where Cohen's Kappa (.66) could be considered fair (Landis & Koch, 1977, Fleiss, 1981). Accordingly, since the percentage of agreement did not consider the likelihood of agreement between users occurring by chance (Cohen, 1960), NVivo calculated the Kappa coefficient independently for each combination of node and file (QSR International, 2021). According to the company's support documentation, this approach typically results in a high percentage of agreement and a moderately high Kappa value. The coded units in the interviews were tabulated using NVivo matrices. This method, as discussed by

Coniam (2011), allows researchers to comprehensively analyze data rather than selecting quotes arbitrarily to support biased viewpoints. Additionally, it enables researchers to derive quantitative insights from qualitative respondent data (Coniam, 2011; Feng & Behar-Horenstein, 2019).

5. Results

A total of 48 pre-service teachers completed the questionnaire. Their responses were analyzed and coded using the scheme described earlier (Data and Analysis section). The analysis resulted in 310 codes, with 46% pertaining to GBL methods and 54% related to the competencies and constraints experienced by the pre-service teachers. Tables 2 and 4 provide a more detailed breakdown. They show the number of codes assigned to various themes and sub-themes, along with the number of participants from each cohort (English as a second language and physical education) whose comments were coded.

5.1 Game-based pedagogical methods

5.1.1. PCaRD

Pre-service teachers' responses regarding the PCaRD model fell into two main categories: their overall impressions of the model's strengths and their insights into implementing the four distinct phases.

Table 2

Coding scheme overview for the GBL methods

[insert Table 2.]

In general, the PCaRD model was found to be a useful and reassuring aid in implementing games, and in linking the fun aspect of games to the educational

objective. According to Table 2, sports teachers had more to say about PCaRD than about GameChangers, and vice versa. Additional illustrative examples of GBL methods can be found in Table 3 (Annexes). The pre-service teachers' statements in English were corrected for syntax and spelling, while the statements of the physical education teachers were translated into English.

Advantages

When creating games, pre-service teachers reported that the PCaRD model helped them make games more interactive, playable, and aligned with pedagogical principles, ensuring they were designed with careful consideration of how pupils learn best and how to effectively facilitate their learning experience. The schematic overview in PCaRD helped participants understand each phase, adapt activities to their target group, link them to disciplinary and curricular objectives, and progress within a specific teaching sequence. Furthermore, our pre-service teachers found the framework, with its comprehensive list of requirements, useful as a guide for integrating games during their internships. The PCaRD model also helped them position themselves within the game since they were assigned a specific role.

Additionally, each element within the framework helped pre-service teachers justify their choice of using a game as a valid pedagogical method. The ability to clearly show the connection between a game (specifically its fun aspects) and a learning objective was very important to them. Several participants expressed this need to affirm the value of their work in relation to their pupils, peers, and nearly all other stakeholders within the institution.

The four PCaRD phases

As explained earlier in this article, the PCaRD model comprises four phases, each including Objectives, Teacher Roles, and a Demonstration of Learning.

Play Phase

The model helped pre-service teachers focus on course objectives and assume different roles during class. They found gameplay valuable for motivating and engaging pupils. Additionally, they were also able to adapt their games to the level of their pupils, help the players improve, and sense pupil satisfaction. As mediators, they observed what pupils did (or did not do) and used the feedback to design upcoming activities.

Curricular Activity Phase

Participants stated that this phase helped them observe the transfer of knowledge and skills acquired during the game, integrate games into an existing curriculum, justify the fun part of the game to their peers (as described in the play phase), and explore content in a new and fun manner.

Reflection Phase

This phase was mentioned by a small number of participants. After taking part in the activity, some pre-service teachers found it necessary to reflect with their pupils on what they retained. The goal was to place learners in an active role to help them process content more effectively.

Discussion Phase

A smaller number of pre-service teachers mentioned this phase, but those who did, valued it highly. They mentioned using pupil interaction as a means of sharing knowledge, summarizing the course, and allowing for questions.

5.1.2. Gamechangers

In response to the GameChangers approach, participants commented on three sub-themes: the advantages of the GameChangers approach, the possibility to reuse existing games, and the ability to connect games with learning. Table 4 shows that both English language and sports teachers appreciated the GameChangers approach, but primarily sports teachers mentioned that the approach helped them to link games with learning.

The GameChangers approach was seen as beneficial for pre-service teachers with limited gaming experience, helping them create their own games. For instance, a pre-service English teacher noted, "Even though I'm not a gamer, I can imagine them and create these games." Through the GameChangers mission structure (considering the rules, developing a scenario, creating a storyboard and a prototype), the teacher takes the lead as the project creator. As part of the university's games course, pre-service teachers were able to exchange ideas with their peers and discuss all aspects of the creation process during the demonstration of these missions. This method helped them more easily find a game that was a good "fit" with the curricular program and met the expectations of their institution. Most participants appreciated the GameChangers approach for its emphasis on creativity, which aligns with Arnab's (2020) vision of empowering teachers to design their own games and fostering engagement through learner ownership and autonomy.

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The "What's your story?" card deck was viewed as an interesting method to learn how games work and how they can be adapted to specific goals. The card game helped them understand that both game mechanics (the rules of a game) and game dynamics (how a game is played) are essential for a smooth game activity. For some participants, the "What's your story?" game provided a sense of relief. Designing a game from scratch had proven too challenging, but they felt comfortable adapting an existing game.

5.1.3. No affinity

Some pre-service sports teachers considered both PCaRD and GameChangers as unsuitable for use in class, but they were unable to explain why. Others found GBL informative but not helpful. A few pre-service teachers had already created and used a game in class before they followed the course and found no benefit in our contribution. A pre-service English teacher explained it like this: "If you understand the rules of a game and you know how to play it, nothing else is required."

5.2. Competencies and constraints

Table 4 summarizes the competencies and constraints pre-service teachers experienced when implementing games during their internship. About a third of the codes (96 out of 263) were attributed to the competencies considered essential for integrating games, with the remaining codes addressing the constraints they encountered. Regarding the differences between the two master's cohorts under study, sports teachers reported more issues related to time and curriculum constraints, while English teachers focused more on aspects of the classroom setting.

Table 4

Coding scheme overview for competencies and constraints

[insert Table 4.]

Additional illustrative examples can be found in Table 5 (annexes). The statements of the pre-service teachers in English were corrected for syntax and spelling, while those of the physical education teachers were translated into English.

5.2.1. Competencies

Game Expertise

Our pre-service teachers found it valuable to have prior experience playing games, either by being familiar with the game to be played in class or with games their pupils play on Xbox or PlayStation. They also emphasized the importance of providing their pupils with an immersive game experience, one that allows for natural play without being overly scripted. During their internship, pre-service teachers highlighted the importance of engaging and motivating pupils, managing games as entertainers through gamified content, and fostering collaboration among pupils.

It was also essential for pre-service teachers to have expertise: choosing the right game that corresponds to the educational level of their pupils, ensuring the game is balanced to prevent things get out of hand, to be able to adapt a game and use it at the right time, and to ensure that pupils can learn autonomously. Those who mentioned this latter aspect considered a game

activity a good opportunity to empower their pupils and to allow them, in their role as a teacher, to coach their pupils individually.

In this respect, our pre-service teachers considered an understanding of both game mechanics and dynamics essential. Since no formal training on designing and using educational games is provided to pre-service teachers, they had to learn independently, "with only the aid of a tutorial."

Technology-Related Competencies

Pre-service teachers expressed a need for proficiency in using technological tools, an area where some felt they lacked sufficient skills. A strong technical understanding of software and applications, independent of the hardware they run on (computer, tablet, mobile phone consoles), was considered necessary to create quizzes with apps like Kahoot! (http://kahoot.it) or to develop an online escape game with Genial.ly (http://genial.ly). When creating games on a specific platform, these technical skills become even more critical. Some participants expressed a desire to delve deeper, seeking to learn graphic design or coding to create their own custom applications. This aspiration stemmed from a wish to design games that are not only effective but also visually appealing and engaging for pupils.

5.2.2. Constraints

Time

Pre-service teachers consider games a time-consuming pedagogical approach, requiring them to identify suitable games, ensure they meet curricular, spatial, and time constraints, adapt them, conduct trial runs, and more. Additionally, introducing and explaining the games took longer compared to traditional

methods. They considered it necessary to avoid running out of time during gameplay, and to ensure there is enough time at the end of the lesson to dispel the excitement. In this respect, the pre-service teachers need to make sure that their pupils do not get too distracted by the gaming devices (tablets, software, etc.) and that all pupils can play at the same time (which can be challenging with classes of 30 pupils). Additionally, games must be introduced gradually and spread over several courses (which takes more time to prepare than regular courses).

Another time-related problem in class is the time of day the lesson was scheduled. According to the pre-service teachers' experience, the outcome is not the same if the game is played in the morning at 8 a.m. compared to a time slot at the end of the day. Lastly, the time spent changing rooms can add up to 20 minutes (out of 50 minutes lesson) when playing games in a computer room or sports class. A pre-service physical education teacher said, "if you add up the extra time to set up and play the game, this implies that it is sometimes just impossible to use a more creative approach like games."

Classroom and classroom equipment

Most English pre-service teachers faced challenges with computer lab availability. Not only were these rooms not always available when needed, but booking them in advance at the beginning of the year limited access for other teachers throughout the school year. In addition, many computer rooms are not well-equipped; for example, some computers require a lot of time before they are ready for use, making it impossible to use them for gaming. In some cases, the Wi-Fi can be too slow to use online applications or to function properly

altogether. Similarly, some printers can only print in black and white, making printed game material less appealing.

Computer rooms are sometimes subject to restrictions. Access to certain websites is denied because the antivirus software does not authorize them, or the IT technician refuses to install them. In addition, as mobile phones are (mostly) forbidden in primary and secondary education in France (Peraya, 2018), multiple choice quizzes like Kahoot! are not allowed.

A few schools do not have any equipment at all, which forces pre-service teachers to use only paper, or other non-digital games. They mentioned that they would prefer a situation where all pupils are equipped with their own tablets. In that case, pupils could stay in their own classroom and would not need to move to another room.

Finally, participants found it challenging to organize the classroom. To allow for teamwork and to facilitate the planned activities, the room layout sometimes needs adjustment. Sports teachers mentioned that they need several types of rooms for their activities: an equipped gym, a park outside, or even a classroom with a projector. According to these pre-service teachers, open spaces also make it difficult to manage the class when the pupils are excited.

Class management and pupil behavior

Several pre-service teachers found game implementation impractical with challenging classes, especially when anticipating a lack of seriousness or dealing with overcrowded classrooms. Consequently, data analysis indicates that pre-service teachers had to impose a rigid framework for the game, with

rules being very strict to avoid disruptive behavior or cheating when pupils attempted to win a game at any cost.

Working in groups can also be challenging, as pupils may initially feel overwhelmed. Moreover, teachers must ensure that all pupils participate in group work effectively. Working in separate groups alters classroom dynamics, with each group of pupils expected to work independently and autonomously without disrupting others. To achieve this, a pre-service English teacher emphasized that "it is essential to provide clear instructions at the beginning of the activity, teach pupils how to work effectively as a group, provide support without interrupting each other's work, and actively listen to one another".

Managing pupil behavior can be challenging as well. While some pupils found it difficult to understand the rules, others see it "as a chance to relax without having to speak any English." If games are rarely used, teachers need to integrate them gradually and help pupils become accustomed to the approach.

Curriculum

Many pre-service teachers considered that using games is opposed to ideological, curricular, and institutional norms. The school environment is perceived as rigid, where playing games is considered a fun activity disconnected from learning, and they feel they must constantly justify their actions. Some participants seem to agree with this limited viewpoint, where games are perceived as entertainment without any educational value. The toughest part is finding the right educational game, with a good balance between play and learning, that is relevant to the curriculum. The data further indicates that pre-service teachers wanted to comply with curriculum

guidelines and enhance pupils' knowledge and skills. In this respect, games can be valuable because they offer the opportunity to break the routine and focus on other parts of the course, such as feedback and questions.

6. Discussion and conclusion

The results of this study contribute answers to our guiding questions and demonstrate how GBL can assist pre-service teachers in incorporating games into their teaching practice. Based on these findings, we can now draw some general conclusions and proceed to a direct comparison between PCaRD and Gamechangers.

Firstly, we evaluated the usefulness of GBL methods. Both PCaRD and GameChangers were positively evaluated by most pre-service teachers. All four phases of the PCaRD model were mentioned. Participants mainly benefited from the Play (focus on gameplay) and Curriculum Activity (focus on the link with the curriculum) phases. Reflection and Discussion were seen as valuable but time-consuming phases. While some participants preferred the PCaRD model, others found the GameChangers approach offered more flexibility, particularly useful for creating new games or adapting existing ones. This aligns with our course concept and our experience with prior cohorts since we initially introduced GameChangers as a solution for pre-service teachers who felt limited with only the PCaRD model at their disposal.

According to Hanghøj (2013), pre-service teachers using PCaRD performed as instructors (linking the game with learning objectives and the curriculum) and guides (scaffolding learning during play), but less as evaluators (in terms of

evaluating and discussing). In contrast, with GameChangers, they took on a playmaker role (creating play scenarios).

According to Foster and Mishra (2011), the genre of a game describes "how a particular game integrates pedagogy and technology" (p.43), and it is important for teachers to understand "how different game genres reflect underlying pedagogical strategies that allow for learning in different content areas" (p.34). The authors also state that the integration of the TPaCK approach provides teachers "with a framework for analyzing the content of games and how they integrate with game genres, and through that provide us insight into how learning could occur and how that learning could be assessed" (p.43).

In their paper, Foster and Mishra (2009) emphasize their preference for reusing commercial games off the shelf over educational games, referring to the latter as "chocolate covered broccoli" (Laurel, 2003). This metaphor describes the process of making something unappealing (such as broccoli) more attractive by covering it in chocolate (adding game-like elements to make educational content more engaging). However, this conclusion also suggests that teachers also wish to adapt or design games themselves.

Secondly, we compared both methods to discern the differences. In this regard, we will establish a connection with the taxonomy of design principles by Laine and Lindberg (2020). Following an analysis of 41 studies, the authors categorized a total of 54 design principles into 13 classes: *challenge, control, creativity, exploration, fairness, feedback, goals, learning, profile and ownership, relevance and relatedness, resources and economy, social play and storytelling, and fantasy*. When examining the feedback on PCaRD, it

predominantly aligns with the following categories: *challenge* (design principles aiming to create engaging game challenges for diverse players), *control* (ensuring player actions yield appropriate feedback), *learning* (principles focused on facilitating the learning process), and *goals* (constructing compelling and meaningful objectives). This correlation is unsurprising, considering that the four phases of PCaRD (Play, Curricular Activity, Reflection, and Discussion) also correspond to these categories.

When we undertake the same exercise for GameChangers, it becomes evident that, in addition to the present learning and *control* categories, they also align with the design principles concerning *storytelling* and *fantasy* (enhancing game engagement through storytelling and fantasy), *creativity* (endeavoring to cultivate players' creativity and self-expression), and *social play* (encouraging social interaction to create socially immersive game experiences).

Third, pre-service teachers expressed a clear need for specific competencies and experiences in game-based learning, which their current training often lacks. Experience in playing and creating games emerges as a necessary foundation, alongside understanding game mechanics and dynamics. Several scholars (e.g., González et al., 2016; Chen et al., 2020) emphasize the importance of considering students' activities, behaviors, and motivations during game design.

Digital skills, including coding and familiarity with hardware and software, are also viewed as essential. Zhang et al. (2014) identified the added value of these experiences, while Akcaoglu and Kale (2016) advocate for game design courses to foster positive attitudes towards challenges, problem-solving, and

the design process itself. Their research emphasizes integrating game-based learning (GBL) from the beginning of lesson planning, equipping pre-service teachers with skills to navigate unfamiliar situations. Practicing GBL lesson plans within their specific discipline bridges the gap between game design principles and subject-specific priorities. Matsuda (2019) exemplifies this with a virtual lesson game, helping teachers refine their instructional styles and improving problem-solving abilities.

Fourth, implementing GBL faces constraints such as curriculum and time-related issues and classroom equipment. Games are time-consuming as teachers need to find appropriate games, create or adapt them, test them in a suitable classroom environment, link them to the curriculum, play them in class, and reflect on the experience. Classrooms often lack proper equipment, mobile phones are mostly forbidden in primary and secondary education in France (Peraya, 2018), and Wi-Fi and IT problems frequently hinder the ability to play games. Many authors have reported technical difficulties with hardware and connectivity issues during the development of these activities (Badilla Quintana et al., 2017; Kaimara et al., 2021; Jääskä & Aaltonen, 2022). Additionally, secondary school teachers are less positive about using computer-based games and technology for classroom instruction, compared to primary school teachers (Proctor et al., 2013), partly due to these obstacles.

Fifth, pupil behavior and class dynamics change during gameplay, requiring new organizational, didactical, and pedagogical skills. Students may become overly excited or disengaged as classrooms shift from teacher-centered to student-centered environments in GBL (Watson et al., 2011; Huizenga et al., 2017; Krath et al., 2021; Nieto-Escamez & Roldán-Tapia, 2021). Effective

classroom management is crucial for teaching effectiveness and teacher retention, particularly within the first two years of their careers (Chen et al., 2020; Freeman et al., 2014). Developing specific procedures and routines for behavioral management, among other aspects, is integral to this process, encompassing how teachers establish and enforce rules, initiate lessons, build relationships with students, apply discipline and consequences, and create an engaging learning environment (Diniatulhaq et al., 2020).

Based on the findings of our study, we conclude that both GBL methods, PCaRD and GameChangers, were regarded highly by most pre-service teachers as valuable tools for successfully integrating games into teaching practices. These methods provided them with structured frameworks that facilitated pedagogical decision-making and ensured comprehensive consideration of key aspects during class activities. While the PCaRD model covered essential phases like Play and Curriculum Activity, some participants found it necessary to complement it with the flexibility offered by the GameChangers approach.

Our study underscores the challenges faced by pre-service teachers, especially those with limited teaching experience, in effectively implementing games in classrooms. It is imperative that their training includes practical experiences in game-based learning, deep insights into game design and mechanics, thorough understanding of student behavior and reactions, as well as rigorous lesson planning and effective classroom management. These competencies are essential for navigating complexities such as time constraints, technical issues, effective classroom management, and adapting teaching methods to accommodate diverse learning behaviors.

Furthermore, our findings emphasize the need for pre-service teachers to justify their use of games as a pedagogically sound approach. This aspect demands support and awareness from teacher trainers and school administrators to alleviate the stress associated with integrating games into teaching practices (Börü, 2018). By addressing these challenges and providing comprehensive training and support, educators can enhance the confidence and effectiveness of pre-service teachers in leveraging games as powerful educational tools.

7. Limitations and suggestions

The strength of this study is that it integrates two different GBL methods that were tested by 48 pre-service teachers in two different disciplines. Despite our meticulous study design, several limitations remain.

Our research showed that pre-service teachers are interested in both using games off the shelf and creating their own. However, in this study, we only analyzed two GBL methods. Since a single approach can't address every need, future studies should explore other models. We could incorporate frameworks like Winn's (2009) Design-Play-Experience (DPE), which guides the design of learning, storytelling, gameplay, user experience, and technology components. Additionally, integrating Laine and Lindberg's (2020) taxonomy of design principles could provide new insights. Our study focused on two secondary education disciplines, but future research could involve pre-service teachers from multiple disciplines and explore how best to tailor these GBL methods to different learning contexts.

We can further explore how PCaRD and GameChangers can be tailored to address the specific needs and experience levels of pre-service teachers, as well as the complexity of the learning activities they design. For example, we can provide guidance on when to use PCaRD's structured approach, which might be beneficial for novices or for complex learning activities, versus the more open-ended nature of GameChangers, which might be better suited for those with more experience or for simpler learning objectives. Unlike PCaRD, which aligns primarily with design principles related to challenge, control, learning, and goals (Laine & Lindberg, 2020), GameChangers encompasses additional principles such as storytelling and fantasy, creativity, and social play. These elements enhance engagement and self-expression, fostering a more flexible and immersive learning environment (Gee, 2003). Consequently, based on our pre-service teachers' experiences and the work of Gee (2003) and Laine and Lindberg (2020), we hypothesize that GameChangers provides a versatile framework that can accommodate a broader range of learning experiences and adapt to varying levels of complexity. This exploration would provide a more nuanced understanding of how to tailor PCaRD and GameChangers, empowering pre-service teachers to select the most effective method for their specific needs and learning objectives.

Future runs of this course could also help students to find a better balance between play and learning. As mentioned by Mora et al. (2017), applying gamification in an ad hoc manner without the formal process of proven design support risks being less beneficial or even counterproductive. To mitigate this risk, several frameworks have been proposed to help educators implement GBL effectively (Simoes et al., 2013; Wongso & Rosmansyah, 2014). For

example, Simoes et al. (2013) suggest that learning activities should allow repeated experimentation and provide rapid feedback, with tasks adapted to pupils' skill levels and increasing in difficulty as skills improve.

Ensuring that the design process is iterative is another important aspect. A co-design approach (Sousa et al., 2023) tailored to the expertise of pre-service teachers with games could be valuable. Eckardt et al. (2018) emphasize the importance of iterative design and playtesting, noting that many educational games fail because their designers focus on learning goals rather than creating an enjoyable gaming experience that balances learning and fun. Traditional game design processes, including playtests, are seldom used in the development of educational games. Researchers such as Gugerell and Zuidema (2017), Arnab (2020) and Koutromanos et al. (2023) highlight the benefits of co-design processes, which facilitate the exchange of knowledge, skills, and experiences among participants. However, Gugerell and Zuidema (2017) advise that the co-design approach should always be preceded by a conceptual process to ensure objectives and outlines are established before collaboration begins. Although these studies did not focus on pre-service teachers, we believe these approaches could be beneficial for them as well.

Williams et al. (2009) found that pre-service teachers commonly cited collaborating with peers, seeking expertise from experts, gaining hands-on experience, finding information on the Internet, and asking for help from the course instructor as major steps when integrating innovative practices in their teaching. Engaging pre-service teachers in an iterative process that evolves into a co-design approach might help them design effective educational games. Furthermore, researchers like Rüth et al. (2022), Hayak and Avidov-Ungar

(2023), and Webb and Pearson (2008) concluded that the ability of pre-service teachers to integrate games into their teaching practice is related to the skills they acquire. Their work tested a model that divided the development of games into phases, allowing pre-service teachers to learn progressively.

In our study, pre-service teachers were at the novice level. However, we lack insight into which generic competence areas hindered or facilitated GBL implementation (Nousiainen et al., 2018; Puerta, 2024). An inventory of both generic and GBL competencies could help propose tailor-made solutions (Kamisli, 2019; Foster & Shah, 2020). Additionally, understanding the variability in teacher training programs based on prior experiences and internship requirements could enhance research.

Last, curricular and disciplinary constraints considerably bothered our pre-service teachers. They often felt that games were not aligned with school curriculums or could be considered as a curriculum (Foster, 2012). Even when positive, teachers sometimes felt the need to justify actions they considered contrary to ideological, curricular, and institutional forces. The semantic connotations of the word "game" may influence pre-service teachers, who often mistake it for "play," describing it as "a more enjoyable activity without strict rules or educational objectives." This distinction is highlighted by Deterding et al. (2011), who discussed the semantic divergence between "game" (rule-oriented) and "play" (less rule-bound). Additionally, the "hidden curriculum," described by Orón Semper and Blasco (2018), involves the transmission of norms through the school context or by colleagues and management, strongly influencing pre-service teachers' values and behaviors. Some teachers were explicitly told that games were not acceptable learning

tools, while others received this message more subtly. Future studies could explicitly investigate the impact of the hidden curriculum on the acceptance and use of educational games.

8. Disclosure statement

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11.   Annexes

Table 3

Illustrative examples of GBL methods

[insert Table 3.]

Table 5

Illustrative responses for the competencies and constraints

[insert Table 5.]

Table 1

The course's workflow linked to steps withing the GBL methods used

Period	Workflow of the course	Course Topic	PCaRD	GameChangers
Autumn	Course 1	Theoretical introduction to GaNA, PCaRD and GameChangers, experience of Play	Play, Curriculum, Reflection and Discussion	Mission 1
Autumn	Course 2	Re-use an existing game		Mission 2 and 3
Spring	Course 3	Create a new game		Mission 3 and 4
Spring	During internship	Play game in class		
Spring	Course 4	Reflect on the game experience in class	Reflection and Discussion	Mission 5 and 6
Spring	Exam	Questionnaire (interview instrument)		

Table 2

Coding scheme overview for the GBL methods

Themes		Sub-themes	Codes	Students (N=48)	Eng (N=18)	% (N=18)	Sport (N=30)	% (N=30)
GBL Methods	**PCaRD**	Advantages	16	16	4	22%	12	40%
		The four PCaRD phases	25	25	8	44%	17	57%
	PCaRD	Count	41					
	GameChangers	Advantages	18	16	7	39%	9	30%
		Reuse games	3	3	2	11%	1	3%
		Link games to learning	10	10	2	11%	8	27%
	Total GameChangers	Count	31					
	No affinity	No model was used	15	15	7	39%	8	27%
	Total GBL Methods	Count	143					
		% of total coding	46%					

Table 3

Illustrative examples of GBL methods

	Examples	Eng	Sport
PCaRD	Advantages	The PCaRD model did prove useful in my creation of the game, as it designs opportunities for interaction, and communication was at the core of the game played in my class. It wasn't an immersive gameplay, but it did enhance and support my learning goal (vocabulary and grammar acquisition), encouraging learners to reflect on their learning and express their understanding.	I used the PCaRD model in only one of two classes, and I saw a clear difference between them. Pupils in the PCaRD group became more immersed in the game, more autonomous, and I did not need to explain it all over again.

	The four PCARD phases	The PCaRD model proved to be very useful as it provided me with a holistic methodology for game creation. The first three steps, in particular ("Play," "Curricular Activity," and "Reflection," respectively), allowed me to reflect on the disciplinary objectives (vocabulary of world geography), on my audience (5th grade pupils), and on my stance and role in this game (partial withdrawal). I also observed the transfer of skills/knowledge acquired by pupils during the game and their subsequent application in a more traditional context (worksheet exercises).	The PCARD model allowed me to make the objective explicit for the pupils and to consider their feelings to improve or adapt the game according to their profiles. Moreover, the model helped me determine my role in the game.
	Advantages	This model helped me when I needed to devise a new work unit. I had chosen the 'Bullying' theme, and I knew I wanted my pupils to develop their writing skills. However, I had no idea how to engage them without risking boredom, so adopting a 'game approach' was essential.	The approach was better suited than the alternative method to both the educational requirements and the needs of my pupils, allowing for greater flexibility and creativity.
GameChangers	Reuse games	I created my game using the same rules as the "Create Your Own Story" game.	The Game Changers approach was most promising and practical because it is the teacher who is at the heart of the project and who is the game designer. They can consider the specificities of the pupils they are teaching, incorporate institutional expectations, and modify the scenario, the rules, and the outcomes as they wish.

	Link games to learning	They were helpful in that it reassured me in my vision that even if I am not a gamer, I can imagine and create games.	This method facilitates the integration of games because each mission allows for justifying its usage and thereby becoming legitimate in the eyes of other teachers.
No affinity	No model was used	I found both models interesting to study and believe they would certainly inspire my future teaching practices. However, I chose to implement a simpler oral game with my pupils, deviating somewhat from the models.	For our game, the model wasn't very beneficial to us because we relied on more traditional games (cards).

Table 4

Coding scheme overview for competencies and constraints

Themes	Sub-themes		Codes	Students (N=48)	Eng (N=18)	% (N=18)	Sport (N=30)	% (N=30)
Competencies and constraints (CC)	**Competencies**	Game expertise	52	39	14	78%	25	83%
		Technology-related	44	40	13	72%	27	90%
	Total Competencies	Count	96					
	Constraints	Time	29	27	6	33%	21	70%
		Classroom	10	10	7	39%	3	10%
		Classroom equipment	40	29	10	56%	19	63%
		Class management	28	25	10	56%	15	50%
		Pupil behavior	43	31	9	50%	22	73%
		Curriculum	17	16	2	11%	14	47%
	Total Constraints	Count	167					
	Total CC	Count	263					
		% of total coding	54%					

Table 5

Illustrative responses for the competencies and constraints

	Examples	English as a second language	Physical education
Competencies	Game expertise	I believe it's essential for a teacher to have played games themselves before attempting to create them. It seems implausible to me that someone could develop games without firsthand experience playing them.	I must be able to create a game or be able to find a game, play it, and understand its usage and significance to teach it.
	Technology-related	Yes, I think it could have been more appealing if I had used a technological game. I already use Kahoot in class and the pupils love it	I must develop digital skills to innovate and make the games I propose to pupils during warm-up more attractive.
Constraints	Time	The hour of the activity will produce different results depending on whether it's conducted at 8 a.m. or 4 p.m.	If we use a digital tool, we must ensure that pupils do not spend more time on the digital tool than they do on actual practice and developing their motor skills.
	Classroom and classroom equipment	The way the classroom was organized was a constraint. I had to change the layout of the room to enable teamwork and allow the pupils to use computers to create the presentations.	I was able to test my game, but only with traditional tools as my institution lacks the necessary equipment. I only had my personal digital tablet to explain how the game works and its scenario. I hope to have access to more digital tools one day to make my game even more interactive and to stay up-to-date with the latest technological advancements.

Class management and pupil behavior	A problem that was particularly evident during the escape room game was the high level of excitement that the game "spirit" elicited. It was challenging for pupils not to get carried away, and the noise became so loud at times that I had to warn pupils that the game would be canceled if I needed to ask them to calm down again.	Pupils are sometimes overly fixated on the tools and spend time repetitively performing motor actions, which may lead to less effective learning.
Curriculum	I used to implement a lot of games in my teaching while in primary school (I was a primary school teacher before, for 15 years). But now I just feel stuck: there is no equipment available, and I can't change anything as an intern.	As a teacher, I must fully master the school curriculum to ensure that the game used aligns well with the disciplinary and educational cycle-related programs.