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Teacher Competencies in Game-Based Pedagogy *(submitted)*

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Abstract

This study examines what kind of competencies teachers need in using game-based pedagogy (GBP). In our conceptual framework, GBP entails four approaches: using *educational games* or *entertainment games*, learning by *making games*, and using *gamification* in learning. Our data, consisting of teachers' documentation, thematic interviews and questionnaires, were analysed using qualitative content analysis. Four main competence areas were identified: *pedagogical, technological, collaborative* and *creative.* The results are applicable for developing teacher education and in-service training, as teacher competencies in game-based learning will be more integral to teachers' professional knowledge and skill repertoires.

Keywords: Teacher Competencies, Game-based Pedagogy, Case Studies, Educational Games, Elementary Schools, Educational Technology

1 Introduction

Novel technologies and games play an increasing role in twenty-first century education (Van Eck, 2006; Kapp, 2012). In a digitalised society with renewed curricula, successful, meaningful integration of new tools and technology into teaching and learning depends on teachers' ability to a) structure the learning environment in new ways, b) merge new technology with a new pedagogy and c) develop

socially active classrooms encouraging cooperative interaction, collaborative learning and group work (UNESCO, 2011). This requires broad management skills and teacher roles.

In game-based learning, research shows that teachers perform multiple roles: instructor, playmaker, evaluator, afforder, leader, coordinator, tutor, motivator and facilitator (Hanghøj & Brund, 2011; Kangas, Koskinen, & Krokfors, 2017). The teacher is an agent connecting game-based learning to the curriculum; selecting learning objectives and subject-related content; planning, organising and facilitating learning; and evaluating learning processes (Sørensen, 2011; Kangas, 2010b). Technologies and games do not guarantee meaningful (active, intentional, constructive, collaborative, interactive, authentic, transferable) learning experiences (Löfström & Nevgi, 2007); much depends on teachers' pedagogical practices (Rikala, 2015), knowledge, skills (Shah & Foster, 2015), personal interest and pedagogical and emotional engagement (Kangas, Siklander, Randolph, & Ruokamo, 2017).

Teachers have been underrepresented in game-based learning literature; comprehensive approaches to teachers' competencies in game-based pedagogy (GBP) are rare (Foster, Shah, & Duvall, 2015; Hwang & Wu, 2012). Most approaches assume that game-based learning's effectiveness is solely due to the game effect (Foster et al., 2015; Young et al., 2012). However, an approach is needed where this effect is studied while also considering teachers' competencies and roles, the game-based learning process and the context the game is integrated into (Foster et al., 2015; Kangas et al., 2017).

This paper focusses on teachers' competence areas related to GBP in the basic education context, considering teacher competencies and GBP in a broad pedagogical perspective, including teachers' activities in actual teaching practices and processes — before, during and after game play inside/outside the classroom (cf. Kangas et al., 2017). Our focus entails nondigital learning environments as well as digital games. Based on authentic implementations of GBP, we aim to answer the research question: *What kind of competencies do teachers need in using different game-based pedagogical approaches?*

2 Theoretical Background

The study consists of two key concepts: game-based pedagogy (the context for the research) and teacher competence (the investigated phenomenon).

2.1 Game-Based Pedagogy

In our conceptual framework (Figure 1), GBP can be implemented using four approaches (Nousiainen, Vesisenaho, & Eskelinen, 2015) — using *educational games,* using *entertainment games*; learning by *making games*; and using game elements in non-game contexts, i.e. *gamification* — applied in digital and nondigital game-based learning. The first three categories are based on Van Eck's (2006) definition of game-based learning, while gamification has recently become prevalent as a concept (e.g. Deterding, Dixon, Khaled, & Nacke, 2011; Kapp, 2012). In the framework, the term 'playfulness' as a mindset and stance cross-cuts all game-based approaches.

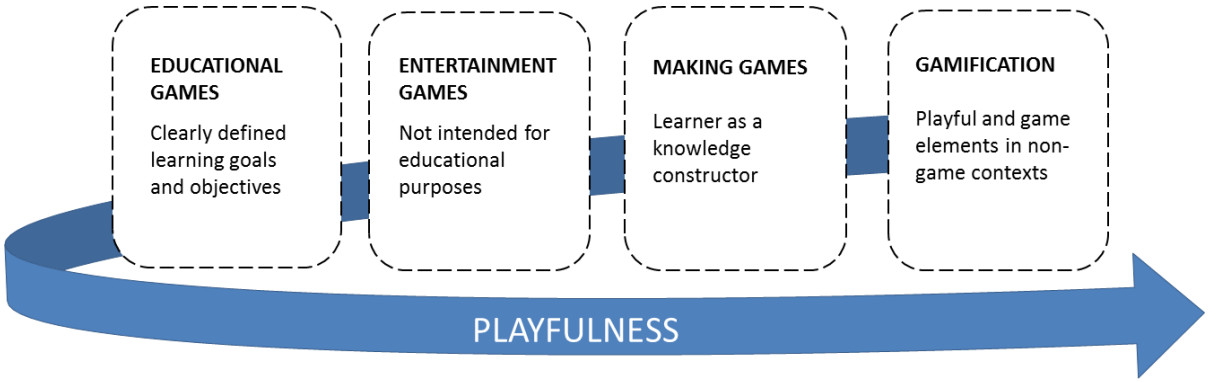

Figure 1. Conceptual framework for GBP.

In practice, different game-based pedagogical approaches often coexist and overlap. For example, in a scenario where a learning project is loosely based on a fictional narrative, one task might involve solving a mystery within an entertainment game, another involve demonstrating a specific skill in an educational game, and yet another requiring creating a challenge for other learners by making a small educational game using a game-creation tool.

Educational games, designed to address specific learning objectives and support the learner in reaching certain outcomes (De Freitas, 2006; Dondi & Moretti, 2007), are often the most approachable way of bringing GBP into teachers' practices. They also lend themselves to study of their effectiveness; much research focuses on the learning effects of particular educational games. Positive learning effects and experiences have been found, for example, in science (Corredor, Gaydos, & Squire, 2014; Squire & Jan, 2007), mathematics (Kebritchi, Hirumi, & Bai, 2010; Shin, Sutherland, Norris, & Soloway, 2012), literacy learning (Richardson & Lyytinen, 2014), collaboration (Hämäläinen & Oksanen, 2014), and the self and identity (Chee & Tan, 2012). Usually, games are brought into class to enhance learners' motivation, but the potential motivational effects of educational games do not necessarily last beyond the initial novelty of the activity (Ronimus, Kujala, Tolvanen, & Lyytinen, 2014). Another challenge relates to whether the learning content is adequately integrated with the game mechanics and to what extent the game supports the learner in focusing on aspects essential for learning (Devlin, 2011; Egenfeldt-Nielsen, 2011). Consequently, promoting game-based learning at school can be sustained, according to Shah and Foster (2015), in cases where teachers' knowledge of games and their curricular relevance is sufficient.

An alternative approach is to build on the inherently motivating nature of *entertainment games,* not primarily intended for educational purposes and therefore requiring more from the teacher, as there is no built-in pedagogical content, and the existing content may sometimes be incorrect or misleading (Van Eck, 2006). Yet entertainment games lend themselves to flexible use, so with innovative ways of applying and integrating them with other practices, they can be useful (Van Eck, 2006). Teachers must attune learners to what is important *within* the game and support their learning *beyond* the immediate game design (Gresalfi, Barnes, & Pettyjohn, 2011) with additional activities complementing game play and expanding the game world and narrative beyond the game itself (Charsky & Mims, 2008; Van Eck, 2006), often through providing a narrative context, challenge or mystery (Nousiainen et al., 2015).

The third approach to implementing GBP is *learning by making games* as individual tasks or larger game-based projects (e.g. role play), producing several benefits (Kangas, 2010a; Vos, van der

Meijden, & Denessen, 2011; Yang & Chang, 2013). One goal is enhancing students' understanding of specific learning content; thus, when designing and building a game — as opposed to merely playing one — the learner must effectively construct new relationships with knowledge and learn new things (Kafai, 2006). Making games has recently also been closely connected to the development of learners' key competencies such as thinking skills, ICT competencies and creativity (Hayes & Games, 2008; Kangas, 2010; Pelletier, Burn, & Buckingham, 2010; Yang & Chang, 2013) through learning programming tools and concepts (Hayes & Games, 2008), learning by doing and playing with game objects (Kafai & Resnick, 1996) and learning by using narrativity (Kangas, 2010b; Robertson, 2012). Game design forces students to solve problems and consider things from different viewpoints (Kangas, 2010a; Randolph, Kangas, Ruokamo, & Hyvönen, 2016).

Gamification is the most challenging approach to define. It turns a non-game activity into a game to make it more attractive and motivating (Deterding at al., 2011; Farber, 2015; Stenroos, 2015). Game thinking and game elements engage learners (Deterding et al., 2011; Kapp, 2012) and effectively extend learning (Farber, 2015), supporting its cognitive, emotional, or social dimensions, particularly the latter two (Dominguez et al., 2013; Lee & Hammer, 2011). In practice, gamification takes a wide range of forms from simple "pointification" to activities consisting of different game-like, narrative, playful elements, often crossing borders between subjects and grade levels (Farber, 2015; Nousiainen et al., 2015). Typical examples of gamification include rewards, points, badges and leader boards (Farber, 2015; Stenroos, 2015). However, it is problematic to use gamification in school contexts merely as a reward system or understand it in terms of mechanics, neglecting other elements more important to the learner's motivation, engagement and experience (e.g. storytelling, character development, challenge and problem solving) (Farber, 2015; Kapp, 2012). It is thus justified to ponder whether to focus on using 'fun' created by game-like interaction to make simple tasks rewarding (Stenroos, 2015; McGonigal 2011) or to strive to promote interest and engagement in learning goals through game-based learning.

Playfulness is central in creating intrinsically motivating games where the activity is experienced as enjoyable and worthwhile for its own sake (Bateson & Martin, 2013; Csikszentmihalyi, 1993; Stenroos, 2015). In the educational context, playfulness is important in learning (Kangas, 2010b; Resnick, 2006) as a playful approach can increase the likelihood of creative results (Amabile, 1983), creating common ground for collaborative learning and enhancing students' satisfaction with the learning environment (Randolph et al., 2016). The term *playful learning* has been used to refer to learning embedded with playful engagement and creative game creation and gameplay in technology-enhanced learning environments (Kangas et al., 2017).

2.2 Teachers' Competencies

We focus on teacher competencies because of the educational shift towards key competencies — skills students need in the future (Caena, 2014). *Competence* is multi-layered, comprising cognitive, skill-based and affective components — knowledge, skills, attitudes, values and ethics (Binkley et al., 2012; European Parliament and the Council of the European Union, 2006; Spencer & Spencer, 1993). These layers mean individuals should have some theoretical background knowledge of each educational topic, the practical skills to apply this knowledge effectively and a certain attitude and stance (characteristics such as openness, responsiveness, persistence and ability to see failures and mistakes as learning opportunities etc.) (Binkley et al., 2012).

Teacher competence is context-bound, embedded in a system with the social environment and layers of activities and increasingly understood as holistic, dynamic and process-oriented, building on learning research and policy highlights (Caena, 2014). Teaching competence involves both professional and personal elements, integrating personal characteristics, knowledge, skills and attitudes needed for effective teaching in different contexts (Bjarnadottir, 2005; Tigelaar, Dolmans, Wolfhagen, & Van Der Vleuten, 2004), and central elements in most frameworks include competencies in content knowledge and didactic, organisational and scientific competencies. Teachers are also expected to have digital competencies (European Commission, 2017; Johannesen, Øgrim, & Giæver, 2014). Thus, teaching is complicated, entailing a mix of specialised skills and knowledge, including knowledge about the subject matter, methods of teaching and how to integrate different tools and resources (such as games) into teaching and learning (Koehler & Mishra, 2009).

In GBP, teacher competencies encompass different digital and nondigital game-based learning approaches. So far, research has mainly focused on identifying aspects influencing the adoption of digital game-based learning among teachers (e.g. Bourgonjon et al., 2013; De Grove, Bourgonjon, & Van Looy, 2012; Hamari & Nousiainen, 2015; Ketelhut & Schifter, 2011). Issues affecting actual use of digital game-based approaches include, for example, openness towards new technologies, supportive organisational culture, digital self-efficacy and the compatibility of technology with one's teaching (Hamari & Nousiainen, 2015). Variables such as motivation, confidence, knowledge about general game use, knowledge about using games to implement different teaching methods and knowledge about using games to implement pedagogical strategies for teaching subject matter impact and predict teachers' adoption of game-based teaching approaches (Hsu, Tsai, Chang, & Liang, 2017).

Teachers know their roles have changed in using new technologies and digital games, but lacking necessary competencies and training, are unsure how to adopt these changes (Allsop & Jessel, 2015). Hanghøj and Brund (2011) describe four teacher roles related to GBP: instructor, playmaker, guide and evaluator. *Instructor* involves planning and communication; the *playmaker* denotes competencies in communicating tasks, roles, goals and dynamics of the current game. The *guide* supports or scaffolds students during gameplay, and the *evaluator* understands, explores and provides dialogical response to students' gameplay experiences (Hanghøj, 2013; Hanghøj & Brund, 2011). Other teacher roles acknowledged in the literature include the planner of pedagogical entities, organiser, mentor, tutor, facilitator, leader and co-learner (Kangas et al., 2017). Teachers also require game-specific knowledge and ability to analyse a game's technology, pedagogy and content to determine its usefulness in education (Hanghøj & Brund, 2011; Shah & Foster, 2015). Teachers' experience and awareness of the curriculum-relatedness of games is crucial (De Grove et al., 2012).

What, then, are the required teacher competencies in GBP? Earlier research showed that successful, pedagogically meaningful GBP requires an educator's pedagogical and technological competencies and a sound pedagogical model to follow (Barab, Gresalfi, & Ingram-Goble, 2010; Egenfeldt-Nielsen, 2005; Hamari & Nousiainen, 2015; Meyer & Holm Sørensen, 2011; Shah & Foster, 2015; Williamson, 2009). A synthesis of a pedagogical model of creative, playful learning (Kangas, 2010b) and of a model of participative game pedagogy (Krokfors, Kangas, & Kopisto, 2014) is developed and used as an analytic framework in this study (Section 3.3).

3 Methodology

3.1 Research Context

The study was conducted with 15 schools and their partner schools in Southern Finland, participating in a specific networking project on GBP during 2013–2016. Primary grades (6–12-year-olds) were taught in 14 schools, and lower secondary grades (up to 16 years of age) were taught in six schools. School sizes ranged from under 200 students to over 600. In each, two or three teachers were core participants who then further disseminated their experiences to other teachers in their respective schools and networks. On average, thirty active teachers participated; the exact number varied, as some moved to different schools at mid-project. The teachers volunteered to participate based on their interest in GBP.

Participating teachers created plans for applying GBP at school to address particular pedagogical goals, interests and specific challenges. Based on these plans, they implemented different game-based approaches in authentic teaching/learning situations with students. The project provided digital devices and applications, training on different game-based tools and methods and opportunities for sharing and networking both face-to-face and online.

3.2 Data Collection

To examine teacher competencies in authentic, real-life contexts, we employed a case study approach. Case studies are suitable especially when boundaries are unclear between phenomenon and context (Yin, 2003). One main advantage of this approach is its ability to provide and manage different types of data, ranging from documents to interviews and observational data (Hammersley & Gomm, 2000; Yin, 2003). Qualitative and quantitative data were collected throughout the project; we focus on qualitative data related to the teacher perspective (Table 1).

Table 1. Description of data

Type of data	**Description**
Documents	Blog entries, digital portfolios and activity descriptions written by teachers (2013–2016)
Interviews	Thematic teacher interviews (N=6) conducted in 2014
Questionnaires	Open-ended answers from questionnaires to teachers in 2014 (N=19) and 2016 (N=12)

The aim of collecting different types of data was to study teachers' activities and experiences using game-based approaches. First, teachers' *documents* provided overviews of all activities occurring in the schools and teachers' reflections on them. The *interviews* with six teachers delved into their practices in more depth, discussed their observations on the educational and motivational value of GBP and reflected on game-based activities' potential to become a sustainable part of the school's educational practice. The *questionnaires* supported the documents and interviews by corroborating or

complementing the insights provided by them. These questionnaires included both quantitative Likert-scale items and open-ended questions. In this paper, we only use the latter.

The language of the data (documents, interviews and questionnaire answers) was Finnish or, in a few cases, Swedish. The analysis was conducted in the original languages, and data excerpts included in this paper were translated into English by the authors after analysis.

3.3 Analysis

The interviews were transcribed, and the whole data set was then analysed using qualitative content analysis conducted iteratively by the researchers. The analysis began with a data overview during which we identified all references to competencies without yet differentiating them according to more specific criteria. Altogether, we found 232 relevant quotations — descriptions of actions, feelings or reflections related to teacher competencies. As a unit of analysis, we used a quotation, varying from one sentence to a multi-paragraph excerpt.

Next we classified the quotations according to content categories, using a data-driven approach and an open coding procedure without imposing a predetermined set of categories on the data. During this process, some quotations were discarded as too vague or ambiguous. The first cycle of this phase produced seven categories, sorted into four higher-level categories or competence areas. The subcategories were reviewed again, with some further divided, so our final classification included ten subcategories under four main categories.

We also sorted quotations according to different game-based pedagogical approaches and different pedagogical process phases. As an analytical tool, we applied a pedagogical framework for game-based learning (Figure 2), based on two pedagogical models — creative and playful learning (Kangas, 2010) and participative game pedagogy (Krokfors et al., 2014).

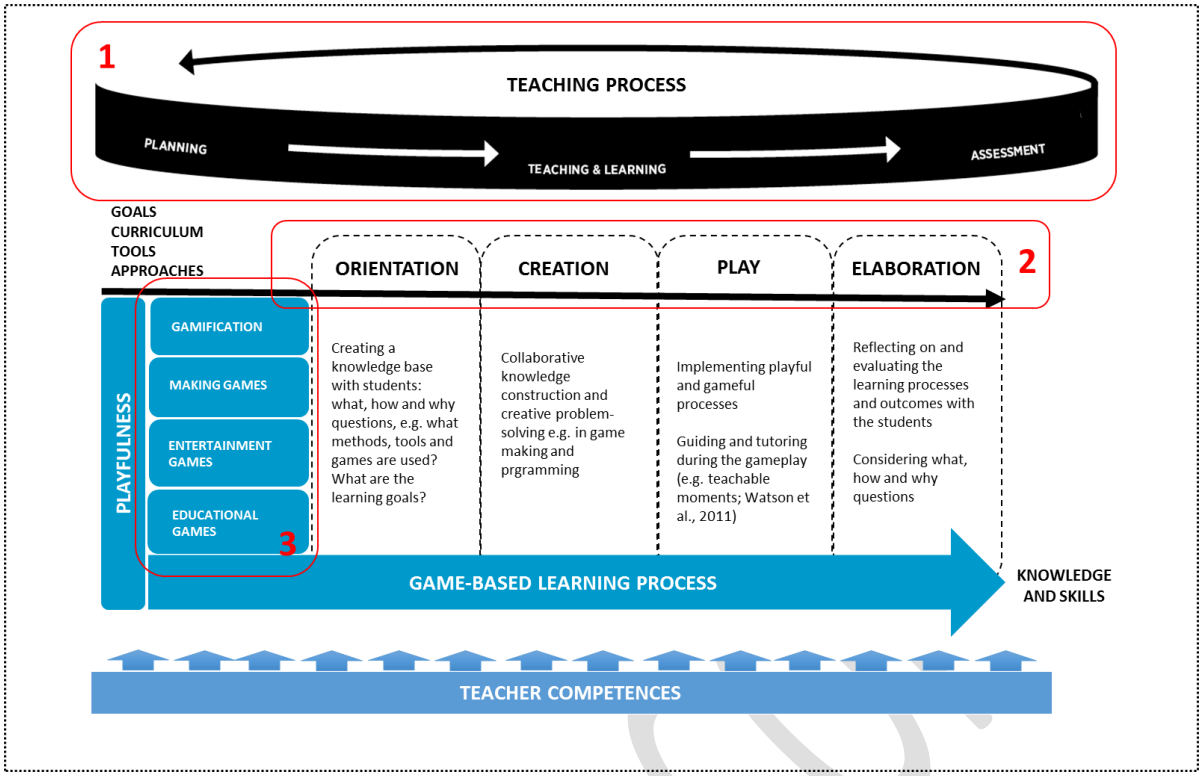

Figure 2. A pedagogical framework for game-based learning.

The teaching process (marked with #1 in Figure 2) comprises initial planning, teaching and assessment. The actual game-based learning process in which students have an active role (#2) is divided into four phases: orientation, creation, play and elaboration. Within each competence area, we identified learning activities corresponding to specific phases of the process. Also, to the extent possible based on the data, we mapped competencies to specific game-based pedagogical approaches (#3). The framework is useful in the analysis process and provides tools for designing teaching based on game-based learning. Guiding questions (Figure 2) in the orientation and elaboration phases may help teachers involve students in the iterative design and assessment of game-based learning.

4 Findings: Areas of Teacher Competence

Implementing GBP in widely ranging ways necessitates varied competencies. The teachers reported that they had used all four game-based learning approaches (Figure 1) in their projects, with educational games most common, while entertainment games, making games and gamification were used slightly less often. In our analysis, gamification was implemented in two ways: role-play activities and the use of points and rewards. Implementations of GBP varied from activities related to one subject to gamifying nearly all classroom activity. Not every activity followed strict game-like rules and structures; some learning processes consisted of general playful elements to motivate students.

Based on our data, we identified four main areas (*pedagogical, technological, collaborative* and *creative;* Table 2) and ten sub-areas of teacher competence.

Table 2. Areas of competence in game-based pedagogy

1. Pedagogical	**2. Technological**	**3. Collaborative**	**4. Creative**
1.1 Competencies in curriculum-based planning 1.2 Tutoring competencies 1.3 Assessment competencies	2.1 Analysing games and technological tools 2.2 Overcoming technology-related obstacles	3.1 Sharing and co-development within the school 3.2 Networking and collaboration beyond the school	4.1 Playful stance 4.2 Ability to explore and improvise 4.3 Creative orientation to self-development

4.1 Pedagogical Area

The *pedagogical* area refers to competencies involved in making pedagogical choices throughout the process of teaching and learning (see Figure 2) in the game-based context. Three sub-areas emerged from the teachers' reflections. First, teachers need competencies related to planning meaningful game-based activities within the curriculum. Second, tutoring competencies (guiding and regulating ongoing activities) are needed, including applying motivational techniques, personalising activities and flexibly regulating the degree of student responsibility. Third are assessment-related competencies, involving both assessing students' learning and reflecting with them on the process. We will now examine these in more detail.

4.1.1 Competencies in curriculum-based planning

In terms of planning, the teachers in our study discussed the importance of meaningfully implementing GBP, where one main competence emerging from their reflections was the ability to apply GBP to support the curriculum. This entailed understanding the strengths and limitations of conveying curricular contents with different game-based approaches when planning learning activities. For example, extensive role-playing projects may engage learners in understanding wider learning goals from different perspectives but may not be ideal for learning specific subject-based details, as stated in the following excerpt. Yet the case may be the opposite when using, or having students create, game-based quizzes or similar products.

> *And of course, like always, the starting point of planning a game, or gamification, is the curriculum. That's where the contents come from. It's just… the contents are transformed into a game-based format. [...] It's probably not like they will remember any specific dates [from history] — the students, I mean, that they would remember some specific detail... but that's not what the purpose is.* [Primary school teacher]

Another dimension of curriculum-based planning is the competence to involve students in defining and formulating curriculum-related goals, helping them orient to these goals (Orientation in Figure 2). For example, teachers defined broad goals for students' activity while allowing them participative

roles in planning more specific methods and learning contents. The excerpt below provides an example of involving fifth-grade students in designing game-based activities for second-graders. The learning process included both game-making and gamification activities in the context of a space-related adventure. The excerpt illustrates how teachers can support students' agency in planning game-based learning, for example, by allowing them to review the curriculum content to integrate it into a narrative frame.

> *First, [the students] were space agent cadets, and after that, our planet/galaxy has been threatened by different threats, and we have been solving them so that we've always consulted the curriculum to see what second-graders have recently been studying. And related to those topics, fifth-graders have organised different kinds of activity points, and that way, we have structured... kind of driven the story forward.* [Primary school teacher]

Teacher competencies also manifested as the ability to plan game-based activities addressing both content-related learning and the development of broader twenty-first century skills. The excerpts below describe how teachers intended to use game-making and gamification to tap into Finnish curriculum goals, namely subject-specific objectives and students' core competencies of programming and collaborative problem-solving skills.

> *The purpose of the [game programming] course is to develop the students' planning and working skills and to familiarise them with the basics of programming with the aid of a visual programming tool, Scratch.* [Primary school teacher]

> *I would think, at least, that the experientiality that comes with [games and gamification] — and cooperation, collaboration, and problem solving — would also make the content more accessible, and the learning… learning would be deeper.* [Primary school teacher]

4.1.2 Tutoring competencies

Tutoring competencies refer to guiding the learning process during game-based activities (Figure 2). One main competence emerging from the data was supporting learners' agency and self-regulation, emphasised especially in broader gamified projects and in making games. In the following, a teacher discusses learning to give the students more authority and responsibility during the game-based process.

> *The emphasis has been especially on [the students] doing things for themselves and also taking responsibility. And you learn to give responsibility — that's another aspect in it. The degree of responsibility can be adjusted very well by the teacher.* [Primary school teacher]

Another teacher described how his class conducted role-play-based projects in geography and history, the learning themes being related, respectively, to travelling in different countries and to life in the Middle Ages. In these broad gamified activities, students self-directedly worked on game-based tasks and produced a final artefact demonstrating what they had learned. The teachers presented a variety of ways and options to do this, and the students chose their preferred method.

> *[The students] have had quite a lot of freedom in planning the final outputs of these game-based projects. Basically, it hasn't mattered to us what the output is. Is it a video, is it a*

> *presentation, is it a game, is it some kind of booklet? They've been free to reflect on what their particular strengths are. [...] We've been demoing Kodu and Minecraft, and some iPad apps, too, to all students — how one can make final outputs with them — and they have all made [final outputs] on a very broad spectrum.* [Primary school teacher]

If the students worked in a self-directed manner, the teacher's tutoring role was to observe the activities, ensure nobody got stuck and ensure the students' work stayed within the general pedagogical frames for the activity. It was crucial that the teacher identify and react to teachable moments (cf. Watson, Mong, & Harris, 2011), for example by providing relevant information when needed. Yet in some cases, the regulation of responsibility meant it was necessary to make the process more structured. This issue arose mainly when using existing games or making games with game-creation tools; sometimes the teacher had to restrict time spent playing an educational game to prevent students losing concentration and becoming bored, while in other cases, more structure was needed if the students' excitement distracted them from the activity's main point.

It is also necessary that teachers' competencies support individual learning trajectories and personalised learning; this requires understanding the characteristics and affordances of different game-based approaches to facilitate learning. In some cases, the most straightforward way to support personalised learning is using educational games where the fastest learners can independently proceed further, while those struggling with learning are motivated to practice more. On the other hand, in broader gamified projects, the teacher can support individual learning trajectories by allowing students to demonstrate their learning in multiple ways, depending on the learning goals.

4.1.3 Assessment competencies

The main required assessment competence was the ability to collect meaningful evidence from game-based activities as the basis for efficient assessment. In the following, a teacher elaborates on this from the perspective of two kinds of game-based approaches: game-making where the students created game characters and related narratives, and the use of an educational math game, *Sumdog*.

> *And through a game-based approach, writing a story… the students can insert themselves into historical stories or horror stories or… It has been motivating. And assessing it is easy. My students have all actually received good grades, [...] because I have so much data on how well they have done. [...] And then again, if I go back to those simpler tools like Sumdog, for example... it tells you directly what the student knows and where they still need some more practice. What percentage [of the tasks] they get right, and so on.* [Primary school teacher]

In broader gamification projects where the activity stretches over a long period — perhaps even the whole school year — the collection of process-related assessment data is especially important. The teacher should be able to envision the kind of evidence needed for assessment purposes and plan ways in which the game-based activity produces this evidence. This necessitates the ability to form a clear overall picture of the whole activity as well as some knowledge about learners' roles in game-based processes to enable personalisation in the assessment phase. In the following interview excerpt, two primary school teachers discuss process-related assessment, addressing the need to observe the process comprehensively, including both subject-related content and students' core competencies, to identify different ways in which students may demonstrate their learning during the activity. Another point mentioned is the need to know ways to provide less active students with opportunities to make their skills visible.

Teacher 1: *So, I don't know, maybe [during the process] you can better assess how active and how interested the students are, and what their interaction skills are like. Kind of general [skills] like that. On the other hand, some surprising skills may also emerge in some students, which are not revealed in normal classroom situations, and that can, of course, affect assessment just as much. And why not, if someone turns out to have more skills than he/she [normally] shows.*

[...]

Teacher 2: *[...] In some situations, it might be useful if someone could develop a good, kind of, set of assessment criteria. Like how to observe the students' activities in a game-based process. [...] What kind of roles appear in those situations? And are some [students] left out? How to assess someone who doesn't necessarily participate so much?*

Researcher: *Mm, that's a really good point.*

Teacher 2: *Like, for example, the teacher can give those students [...] observer's tasks or other kinds of tasks. [...] And it's not inferior in any way to those who participate [more actively].*

Researcher: *Everyone gets to use their own strengths?*

Teacher 2: *Yeah, yeah, it's quite an applied effort, I think, the assessment. Of course, you have the specific products and tasks you can look at, and those are easy to evaluate. But evaluating the process… there you need to have a kind of comprehensive understanding about it, because there are so many elements there which you can assess.*

Some teachers noted that assessing a game-based process was more challenging, albeit also more rewarding, than assessing traditional assignments and tests. The teacher should know how to establish intermediate checkpoints or milestones to avoid having to look back at the whole process at once:

> *There could be some kind of checkpoints. To create some practices so that along the way, [the students] can somehow demonstrate that they have completed them. And no, I'm not talking about testing here — but something… I don't really know, and that is what I've been thinking about for next year — what the checkpoint could be. Is it some specific achievement, like 'You have achieved these certain goals and you will receive a medal for that' or something like that? It could be something like this. But anyway, the point is that you don't have to look back to the whole process on one day, but instead, you'd have something from the whole duration of the process.* [Primary school teacher]

Competencies supporting students' agency are also related to assessment. Several teachers mentioned the importance of evaluating activities and reflecting on the learning process with the learners themselves (Elaboration in Figure 2); for example, discussing whether the students felt like they learned the same things through game-based activities as they would have learned from books.

4.2 Technological Area

The technological area comprises issues related to two aspects of technology-related competencies. On one hand, the teachers referred to issues related to the ability to analyse games and technological tools to select and combine them with nondigital tools in pedagogically meaningful ways. But they acknowledged that problems using digital tools were sometimes encountered, and therefore, the ability to flexibly overcome technology-related obstacles emerged as another important teacher competence in implementing GBP. Note that in some game-based processes, technology may play only a minor role; therefore, not all teachers reflected equally on these competencies.

4.2.1 Analysing games and technological tools

In the technological area, teachers need the competence to analyse games and tools that meet learning goals, knowing about available games and applications and being able to select, combine and evaluate relevant games and technology. To genuinely put pedagogy before technology, teachers may have to look beyond the most obvious, easily accessible alternatives; one teacher mentioned that he tried to produce novel, different ways of using technology instead of always resorting to solutions easiest to implement (e.g. QR codes). This requires prior knowledge of available tools and means of accessing additional resources. However, sometimes ideal solutions are found only after less successful attempts; therefore, readiness to continuously evaluate and reassess tools is required. In the following interview excerpt, a teacher critically reflects on choices he previously made, and based on experience gained from this game-based project, considers what kinds of games would be suitable for maths.

> *Well, [previously] I probably didn't pick games that were so suitable pedagogically. In maths, you [should have] games which help [the students] learn well and help the students to understand exactly what they are doing. Some drill exercises can also [be done] on the laptop, but they are sometimes pretty boring to do — but if it's in the form of a game, then it might be a bit more [interesting].* [Lower secondary school teacher]

4.2.2 Overcoming technology-related obstacles

Solving technology-related challenges and problems is also part of the technological competencies involved in GBP; in this area, teachers often reported experiencing a lack of competence and a need to learn more. They sometimes encountered difficulties trying to prepare devices and applications in advance to ensure a problem-free learning process; often, a cycle of trial and error was required to find working solutions. For example, due to unavailability of a specific cloud-based service, one class encountered problems when it was time to save their final outcomes; it required some effort to find and test alternatives.

Even if a teacher tries to prepare as carefully as possible to use technological tools, difficulties may emerge during game-based activities, so the teacher needs the competence to devise an alternative plan quickly in case some activities cannot be conducted as intended. Advance preparation of Plan B is useful, yet it will often be necessary to improvise and modify the learning goals and tools during the process. The more alternative tools the teachers know, the less the learning process will be derailed by technological problems. One particular difficulty was the uncertainty related to identifying when a technical problem was solvable by the teacher and when it was external (e.g. a problem with the wireless network, a missing component such as a SIM card or a device malfunction). Some teachers

acknowledged the occasional emergence of technical problems yet were fairly confident about being able to solve them so they will not disrupt the activity.

> *When the network or the devices don't work, the students get frustrated quite quickly if they aren't able to do [their tasks]. One teacher alone can't always simultaneously solve problems and come up with other things to do in case the original plan can't be followed.* [Primary school teacher]

As mentioned in the above quote, one teacher alone cannot solve everything. Competence to overcome technical problems also entails knowing where to look for answers and who to ask for help. Being aware of relevant online resources (e.g. video tutorials and online communities), attempting different solutions despite uncertainty of their workability and not hesitating to involve colleagues and students in problem solving are all part of this competence set. Teachers discussed how they often typically avoid novel tools, especially technology, feeling they have not sufficiently mastered their use. However, they also mentioned practices where hands-on collaboration between teachers — especially with those less experienced with technology — worked well in boosting confidence and competence in using game-based approaches. Clearly, the technological competence area is closely linked with the collaborative and creative areas.

4.3 Collaborative Area

The collaborative area relates to teachers' ability and readiness to share and communicate content, ideas, practices and technological know-how. Collaboration is required to introduce GBP into school culture and especially to make it a sustainable practice. This area emerged in our data at two levels. First, applying game-based approaches and practices requires support by the school; second, collaboration beyond one's own school was also discussed. Teachers in this study participated in a project with many opportunities to collaborate with teachers from other schools, which may have been one reason for emphasising cross-school collaboration.

4.3.1 Competencies for sharing and co-development within the school

According to our data, teachers still have much to learn regarding mutual sharing of practices and ideas. They discussed what was required for sharing to become routine and what potentially hindered it. Despite their doing an increasing amount of teamwork, the ability and willingness to share was considered an area for improvement.

As means to improve collaborative competencies, the teachers emphasised mutual support, joint idea creation and demonstration of concrete practices. Based on their experiences, key points in enhancing these skills included openness to new approaches, concrete collaboration by co-developing something with experienced teachers, identifying hidden know-how among teachers and developing new solutions and conventions for sharing ideas and materials (e.g. with the aid of digital technology). One highlighted issue was the necessity of starting small and gradually broadening the approach by sharing and engaging with others.

> *I think the key [to encouraging other teachers to try game-based pedagogy] is to engage them, like 'Let's do this thing together and see what we can come up with.' […] If you only*

> *give a [...] lecture on what you have done, the other teacher will certainly feel a bit left out.* [Primary school teacher]

> *We haven't really found any specific ideal solution [for sharing], but whenever someone likes something or adopts a new thing, they can share it forward, and little by little, the stream becomes a river and a lake.* [Primary school teacher]

4.3.2 Competencies for networking and collaboration beyond the school

The teachers also mentioned extending collaboration beyond one's own school and exploring opportunities for sharing and co-development with teachers from other schools. Cross-school collaboration necessitates adopting a broader culture of sharing and willingness to accept challenges. Similarly, like within-school collaboration, sharing with teachers from other schools takes various forms. The more concrete the collaboration, the more rewarding it was considered by the teachers; to develop one's competencies, a joint project and/or participant observation in another school bore more fruit than merely listening to or reading about what others did. However, oral or written accounts of other teachers' implementations were considered useful sources of ideas.

> *We networked, and now we have a joint game between [four schools]. And we are thinking about what we could do together at some point so that we'd get more students [involved]. We, the teachers, are going to go and visit different schools, and different students and teachers.* [Primary school teacher]

Gamification was also reported to have become more widely used during the project, as it spread from a small group of teachers to colleagues within and beyond the school (see also Nousiainen et al., 2015). For schools in our study, participation in a joint networking project facilitated collaboration across schools; valuable ideas and partners could also be found through online professional communities.

4.4 Creative Area

The final teacher competence category is the *creative* area. In our data, this competence manifested as the ability to take a playful stance, explore and improvise and as the teacher's creative orientation towards self-development.

4.4.1 Playful stance

Playful stance is the ability to see playfulness in almost any learning activity. The teachers discussed the notion of having a world view where anything can be turned into a game by using game mechanics to engage learners. This was mentioned especially by teachers with a personal interest in gaming, role playing, storytelling or related themes, who felt motivated by inventing new game-based elements in their teaching — but it was not limited only to them. Some teachers noted that school inherently includes many aspects which can be considered gamification, even though teachers do not necessarily view them that way, and that teachers can start making their teaching more playful and developing gameful thinking just by building on these existing characteristics. In the following example, a teacher discusses beginning a learning task with a funny role play, providing a playful context for the students' work.

> *You can turn everything into a challenge, or a story, or anything. […] And because games are always built on a story, so I think you just… You can just start a lesson like, for example, I rubbed some red paint or something on my face and came in through the door like, 'Nooo, I'm not [teacher's name], I'm [a] brain researcher, and I've forgotten everything I was supposed to lecture you about the brain. So you have to research for yourselves!' In a way, that's a game too. You have a challenge, and you have a narrative, drama... and the substitute teachers are sitting next to me and staring at me like I'm crazy. [laughter] And then the students get to work for 45 minutes.* [Primary school teacher]

The activity itself (having students research a topic) was nothing new; it was something all teachers do. However, with small adjustments, it can be made a playful task through the teacher's playful stance towards his/her teaching practices.

4.4.2. Ability to explore and improvise

Another closely related point is a readiness to iteratively explore and improvise: to experiment with new tools and methods without worrying about failure, to 'jump into the unknown' with students and improvise on the go to seek activities which feel natural and motivating to teacher and students alike. In many excerpts, teachers mention that it is fun and motivating to try new things and see where they lead, and if the experimentations are successful, these tools and methods become established practices. For some teachers, competencies related to exploration may come naturally due to their personal interests. However, others can also develop them by experimenting with small steps at a pace they are comfortable with.

> *In sixth grade geography, we're studying Asia. My class and I have not tried a role-playing game before, except on a very small scale in history, so I think there will be lots to develop and learn, but I will start somewhere and improve as I go.* [Primary school teacher]

> *And I guess it's [partly because] I was always the geek of the class myself and always liked to make things like role-playing games when I was a young boy, so it somehow feels like a natural part [of the job] that you just start exploring, doing and looking for motivating ways to teach.* [Primary school teacher]

Finally, the teachers also described situations where their original plan did not work as expected and they had to react flexibly and adjust the pedagogical idea of the activity on the go. This necessitated improvisation skills.

4.4.3 Creative orientation to self-development

A third closely related point is a readiness to continuously develop one's professional competencies and reflect on and reshape one's teacher identity. Regardless of teachers' previous experience, game-based approaches challenged them to rethink and enhance their practices. In the following, a teacher discusses how implementing GBP enhanced his own competencies which, in turn, will benefit his students.

> *It's been fun to take up a broader… um, to experiment again with a bit more different thing. And that has indeed brought a great deal of value to this work, like, you want to develop yourself and take your own professional competence further, and then, in a way, to use this professional competence for the good of the students.* [Primary school teacher]

Below, a teacher describes how motivating and fun it is to develop as a teacher in game-based learning and reflects on how important it is to learn to find pedagogical meaningfulness in the use of games.

> *But overall, [game-based pedagogy has been] very motivating. I've experienced it as a motivating, fun and meaningful activity. And in a way, it's also that… If it only was some kind of nonsense without any pedagogical content or without any proper idea, then I'm sure there would also be negative [experiences]: 'We pretended to do something [meaningful] again.' Sure, that works too, but in the long run, it doesn't.* [Primary school teacher]

4.5 Conclusion

This research case focused on competencies teachers found necessary in implementing GBP. The findings highlight four competence areas (pedagogical, technological, collaborative and creative) manifested during the game-based teaching/learning process. Figure 3 summarises how the four competence areas are emphasised in different phases of our conceptual framework (presented in Figure 2).

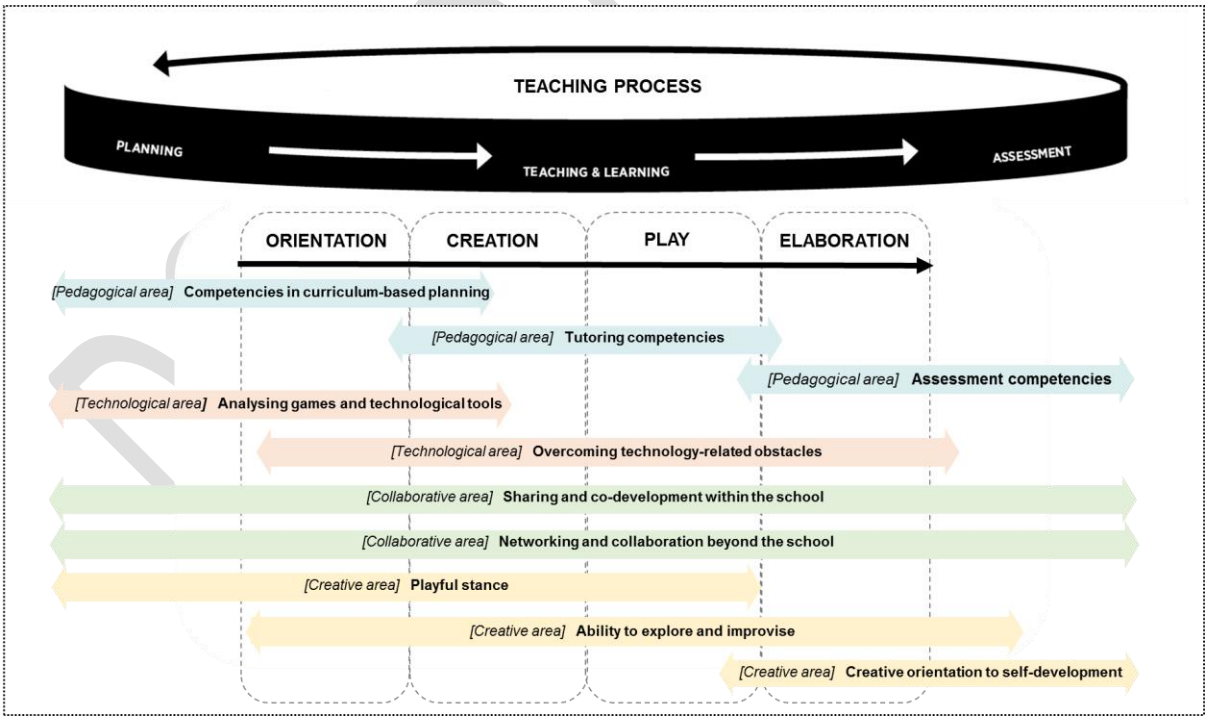

Figure 3. Competences mapped with the pedagogical framework.

As Figure 3 illustrates, competencies related to the pedagogical area closely follow the specific phases of the teaching/learning process. Planning competencies are emphasised when the teacher initially plans the process and when teacher and students together orient to the activities; tutoring

competencies correspond to necessary guiding during actual game-based activities (i.e. creation and play); and assessment competencies refer both to assessing students' learning outcomes and reflecting on the process with them (i.e. elaboration). Regarding technological competencies, skills related to analysing games and technological tools are especially emphasised before and at the beginning of the process, while during the activity, competencies related to overcoming technology-related obstacles emerge as crucial. Collaborative competencies (within or beyond one's own school) are less clearly linked with specific parts of the process; they may be required when planning activities with other teachers, carrying out a joint project or sharing and reflecting on experiences with others. Similarly, competencies related to the creative area apply to all phases of the teaching/learning process. The need for a playful stance manifests throughout the process but is emphasised particularly when planning and conducting learning activities. Willingness to explore and improvise is required especially during the learning activities. Orientation to self-development is emphasised when reflecting on what the game-based activities have taught teachers about their competencies and how this may affect their teacher identity.

5 Discussion

Focusing on teacher competencies is increasingly important because of the international shift towards key competencies in school education curricula (cf. Caena, 2014). The curriculum is key in educational change, defining knowledge and competencies students need in the future (OECD, 2005). For example, the renewed Finnish national core curriculum for basic education requires teachers to develop school culture and pedagogy where multi-literacy and ICT competencies, among others, play important roles (Vitikka, Krokfors, & Rikabi, 2016); teachers are expected to use relevant methods and digital tools to engage learners and promote their key competencies (Binkley et al., 2012). The new Finnish core curriculum seeks to change the approach from *what to teach* to *how to teach,* thus connecting the goals of broad competencies to other learning objectives (Vitikka et al., 2016). For instance, ICT competence as one of the seven competencies defined by the Finnish National Board of Education (2016), or digital competence, defined by the European Commission (Ferrari, 2013), requires related competencies such as skills to interact through a variety of digital devices and applications and to use technologies and media for collaborative processes and knowledge co-creation. The Finnish curriculum also emphasises the role of play and games as learning methods, tools and environments and encourages teachers to use play, games and playfulness in teaching in multiple ways.

5.1 Reflecting on Competence Areas

Game-based learning necessitates careful coordination of various knowledge domains (Bourgonjon et al., 2013); our results show that implementing GBP requires diverse teacher competencies. Four competence areas emerged: pedagogical, technological, collaborative and creative.

First, our results suggest that whatever game-based pedagogical approach is chosen, a *pedagogically* competent teacher can plan, implement and assess playful, game-based learning activities and connect them meaningfully with the curriculum. The results align with previous findings on skills teachers need to implement game-based learning in schools; teachers feel they need enough knowledge and skills in incorporating a game within the curriculum (Foster, Shah, & Duvall, 2016). Based on our findings, a pedagogically competent teacher allows students to participate in planning and designing the forthcoming play and learning activities, methods and (digital) tools. Pedagogical competence

areas — skills to plan, tutor and assess learning processes — cover all phases in playful, game-based learning (orientation, creation, play and elaboration). Regardless of the used game-based approach or how well-designed the games are, the teacher plays an important role in each learning phase as a leader, facilitator, organiser and tutor (Foster & Shah, 2015; Kangas et al., 2017). Pedagogical competencies in facilitating playful, gameful learning refer, for example, to abilities to acknowledge so-called teachable moments — interactional situations where the teacher tutors students' learning process to deepen their understanding of the topic and proceeding in the game (Watson et al., 2011).

Second, teachers should have *technological* competencies, that is, awareness of the nature of different games and their affordances in supporting individual collaborative learning. In practice, technological competencies include the ability to select and combine appropriate games and tools (cf. Shah & Foster, 2015) and see students' and colleagues' expertise as resources in using technologies and overcoming obstacles (cf. Cachia, Ferrari, Ala-Mutka, & Punie, 2010). Technologically competent teachers also understand specific games and digital tools as flexible learning environments to adapt to players' knowledge and skill levels. The results reflect recent empirical findings that teachers need technological knowledge of how to use digital games (Foster et al., 2016) and other playful, game-based learning approaches inside and outside classroom settings. An important question is how teachers see technological problems and challenges — as possibilities, obstacles or non-existent. Earlier research showed that when teachers engage in the pedagogical approach, they have a sense of confidence (Smith & Strahan, 2004) and can solve new problems (Bransford, Brown, & Cocking, 1999). In the digital context, openness towards ICT and ICT self-efficacy positively influences actual use of game-based learning technologies (Hamari & Nousiainen, 2015), and when teachers' comfort and competence are relatively high, they might start designing new, creative, student-centred ways to utilise technology (Rikala, Hiltunen, & Vesisenaho, 2014).

Third, teachers benefit from a range of *collaborative* competencies when implementing GBP; these may relate to teamwork with colleagues within the same school or networking with teachers from other schools and other relevant actors. Collaboration is important because it nurtures novel approaches to GBP. Innovative teaching flourishes when the school culture is collaborative and supportive in terms of peer support and sharing, direct involvement of teachers in practicing new teaching methods and a common vision encouraging novel approaches (Shear, Gallagher, & Patel, 2011). Social influences and the encouragement of the local environment also affect how useful teachers perceive games to be in their work (Bourgonjon et al., 2013; Ketelhut & Schifter, 2011). In our results, this manifested in accounts of how pedagogical practices, knowledge about games and technological know-how spread from more experienced teachers to others, especially through implementing something concrete together. Co-creation and collaboration in the learning process also provides opportunities to identify and link tacit knowledge for completely new openings and ideas (Dillon, Wang, Vesisenaho, Valtonen, & Havu-Nuutinen, 2013).

Finally, in this research case, the *creative* competence area was evident in the teachers' reflections. Playful orientation and stance, improvisation, and orientation to self-development through teacher reflections were regarded as important skills in playful GBP. The findings indicate that to use GBP successfully, it is critical that teachers express a playful stance of exploring, improvising and innovating, motivated to learn and leave their comfort zone. Engaged teachers who express pedagogical and emotional engagement also apply playful learning creatively and exhibit personal entrepreneurship skills (Kangas et al., 2017) and are thus often eager to know how novel teaching and learning methods work (Sawyer, 2012) in improvising and orienting creatively and playfully to pedagogical situations.

We can also look at competencies in implementing GBP through the lens of knowledge, skills and attitudes (Binkley et al., 2012; Tigelaar et al., 2004; see Section 2.2). For example, competencies in the pedagogical area are based on teachers' theoretical *knowledge* of planning, carrying out and assessing the learning process; when applied to the game-based process, these become practical skills. Conversely, while technological competencies also require background knowledge, they are often principally developed through hands-on activities, their starting point within the dimension of practical *skills*. Furthermore, in the collaborative and creative areas, the *attitude* dimension is emphasised. Our results imply that the teachers believe personal stance (including attributes such as openness, persistence and willingness to explore, share and learn from mistakes; Binkley et al., 2012) often is significant in the extent to which these two areas manifest in their work. Thus, knowledge and skills are just the tip of the iceberg (Spencer & Spencer, 1993). Even if teachers have up-to-date technology, knowledge and support, they may not be enthusiastic enough to use technology and games in class (Mumtaz, 2000). Hence, other dimensions underlie and affect technology and game usage (Ertmer, 1999).

Teacher competencies are increasingly important and interesting for both research and policy development, with many related efforts currently ongoing. In parallel with our study, for example, the European Commission (2017) has been developing DigCompEdu, a framework for assessing educators' digital competencies. Several competencies in the DigCompEdu proposal also correspond to those identified in this study in the game-based pedagogical context. Thus, it is important to consider possible synergies between different frameworks and tools. Existing assessment frameworks can be applied in different contexts, including GBP, to support teachers' self-reflection on their competencies.

5.2 Limitations and Implications

Like all studies, this study has some limitations. One was the constitution of the sample; 1) the number of teachers participating was limited; 2) the study concentrated on Finnish schools and teachers (particularly participants in a specific networking project focusing on developing GBP in certain schools); and 3) the responses depended on the teachers' willingness to honestly and reliably recall and report their game-based pedagogies and experiences. Nevertheless, the objective was to reach conceptions and understanding of teacher competencies in playful GBP; thus, even though the data may be specific to particular schools and teachers, the explanations and conclusions can be useful in understanding how other schools or teachers work (Aaltio & Heilmann, 2010; Gillham, 2010).

Teacher education in GBP is still in its infancy and needs a comprehensive approach to develop teachers' competence (Foster et al., 2015). Therefore, this study makes important contributions. The results are applicable for acknowledging competence areas needed in GBP and developing teacher education and in-service training, as teacher competencies in game-based learning will be more integral to teachers' professional knowledge and skill repertoires. This means, for example, developing teacher education curricula and providing courses focussing on pedagogical aspects of using play, games and gamification in teaching and learning. We also argue that the debate on teacher competencies in parallel with renewed curricula is important in order to focus more on increasing teachers' competence areas in terms of GBP. It is also notable that today there are several forums available for teachers to develop their competencies, such as national in-service training projects and informal social media networks.

This study was conducted in a data-driven way to identify the most relevant competencies. One potential future research topic is to delve deeper into the relationship between competence areas and game-based approaches and examine how different competencies manifest when using educational games, entertainment games, game-making and gamification. Also, as the present study was conducted during an ongoing networking project, it will be important to investigate development of game-based pedagogical competencies in a more sustainable context, addressing, for example, teachers' experiences with aspects which have fostered or hindered the development of these competencies in the longer term.

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