Teachers' Perception of Gamification as a Teaching Design

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Abstract. This paper reports on a study investigating teachers' experiences of using gamification as a teaching strategy, in combination with the use of contemporary and emergent technologies in K–12 education. More specifically, the aim was to explore and understand the opportunities and challenges teachers describe by using gamification in teaching. The study was conducted between 2014 and 2018 and included four sub-studies in which university students were given the task of designing gamified teaching activities for school students within K–12 education. This was combined with the use of contemporary technologies such as laptops, media tablets, and emergent technologies such as smart glasses. The university students' gamification designs were tested in school settings within K–12 education. The empirical material is based on observations of the schools' tests and interviews with participating teachers. The findings illustrate three emerging themes concerning (a) *fostering motivation and collaboration,* (b) needing *pedagogical balance to achieve deeper learning* and (c) *organisational changes regarding time and collaboration in teacher teams*. The participating teachers described gamification as an opportunity and a catalyst to motivate school students and have them engage in schoolwork while acquiring knowledge at the same time. However, the challenges and obstacles the teachers perceived in using and designing their own teaching activities using gamification primarily concerned a lack of time and a lack of knowledge of the design process, which they perceived as very complex because it differs from that of their ordinary teaching designs.

Keywords: gamification, teaching strategy, teacher experiences, pedagogical balance, digital technologies

1 Introduction

The importance of student motivation for school performance is well known and has been discussed for decades. However, reports show that Swedish students generally have low motivation to learn in school [1] [2] [3]. According to these reports, the primary reason for this is a lack of variation and individualization in the teaching designs. Research shows that increasing student motivation and their understanding of the learning process will also improve their learning outcomes and performance (e.g.,

[4] [5] [6]). However, many ways of improving student motivation in school exist, and teachers have provided several examples in conversations, in which they explained that they were trying to increase student motivation by using, for example, popular digital games that students played in their spare time. They described the purpose of this as trying to make students perceive the schoolwork as being more fun.

1.1 Different concepts for different purposes

Different concepts exist within this field, such as serious games designed for a specific purpose, including games for health (e.g., surgical trainers or pain-management games), digital game-based learning (e.g., teaching that uses digital games for training specific knowledge, skills), and digital game pedagogy concerning the theory and study of teaching with games [7]. Another concept is gamification. When using gamification as a teaching strategy (i.e., planning and designing school content as a playful experience with a specific purpose to motivate and engage students in doing schoolwork), teachers use similar psychology to what game developers use. Game developers design games to create a strong inner motivation among users to continue playing the game (known as continued levelling up). However, gamification is not about using digital games in teaching but about designing school content and classroom assignments to be more of a playful experience [8]. In turn, this generates positive effects on student learning and student learning outcomes [4] [5] [6].

The concept of gamification has been popularized in many areas over the last several years due to its ability to create inner motivation in different situations unrelated to gaming [9]. Therefore, gamification is based on a similar psychology as used in games by using game mechanics and game dynamics in designing services and products other than games [10]. More specifically, the game mechanics and game dynamics consist of different aspects that address the inner driving forces in human beings to increase motivation and engagement when performing tasks in different situations. For example, Chou [11] created the Octalysis framework for designing gamification activities, which addresses eight core drives that motivate a person to keep moving forward and increase their engagement in what they are supposed to perform (e.g., using game mechanics and game dynamics for a playful experience on any topic). Furthermore, the Octalysis framework addresses the following core drives: accomplishments, meaning, empowerment, ownership, scarcity, avoidance, unpredictability, and social influence [11]. Hence, when a teacher designs school tasks as gamification activities, they must not only consider the content to be taught but also design the tasks that students should perform in ways that will reach their inner core drives (e.g., accomplishments, meaning, empowerment, ownership, scarcity, avoidance, unpredictability, and social influence).

1.2 Gamification as a concept

However, gamification as a concept has been used for not only its ability to create inner motivation in different situations but also its potential to move user behavior in a certain or desirable direction. In recent years, gamification has been adopted rapidly in marketing, ecology initiatives, and customer loyalty programmes such as frequent-flyer programmes or programmes offered by companies such as eBay or Fitocracy. These companies use inner driving forces to encourage and motivate competition between their users [12]. In education, motivation-related research concerns, for example, psychological perspectives such as intrinsic and extrinsic motivation and self-regulation as well as pedagogical methods such as inquiry-based learning [13] [14]. Moreover, Huotari and Hamari [15] described gamification as "a process of enhancing a service with affordances for gameful experiences in order to support users' overall value creation" (p. 19). Hence, gamification in educational settings could be seen as a teaching strategy that uses the advantages of enhancing students' inner motivation to perform tasks [16]. However, because gamification is not about using existing games in teaching or just letting school students compete in order to try to make teaching more fun by gamifying a specific task, gamification in education consequently could be regarded as a so-called teaching strategy. This teaching strategy is performed by using game mechanics and game dynamics in the teaching design, such as by planning content to be taught and designing student activities by addressing the core driving forces. Furthermore, when using gamification as a teaching strategy, the aim is to afford gaming experiences in order to increase the motivational dimensions of curriculum delivery and, in turn, also trying to improve students' academic performance [9] [17] [18] [16] [19]. What might sound simple actually affects knowledge acquisition and the learning experience for students.

1.3 Activating motivation and engagement among students

Studies show that gamification teaching activities can activate motivation and engagement among students but that teachers seem to lack knowledge on how to plan and implement these types of activities because they differ from traditional teaching methods [20] [21] [17] [18] [22]. Even if many teachers believe that gamification could offer a playful experience in schoolwork and, in turn, could increase student motivation and engagement and greatly support the process of learning disciplinary knowledge, teachers do not seem not to know where to start or how to design gamification activities. The studies above show that teachers seem to need help and support when trying to implement this new type teaching strategy. In addition, they also seem to need knowledge on how to think about, act, design, create, and introduce, for example, challenging problem-solving gamification activities. However, the results from the studies mentioned above have raised further questions regarding teachers' perceived problems concerning using gamification in teaching. Why are teachers not approaching gamification as a teaching design even if it is aimed at increasing student motivation and, in turn, improving student academic performance? First, is it true that they are not approaching gamification in this way?

Secondly, if so, what are the opportunities and problems or challenges they perceive? Thus, the aim of this study was to investigate and deepen the understanding what teachers perceive as being the opportunities and challenges of using gamification in their teaching. To clarify, the aim of this study is not to investigate the effects of gamification in teaching nor to teach teachers about gamification but to investigate more deeply teachers' own views of gamification (e.g., how they describe gamification) and their experiences with using gamification as a teaching strategy (i.e., why or why not as well the opportunities and challenges). An additional aim is to investigate the use of contemporary and emergent technologies in this context.

Research Questions
RQ 1: How do teachers describe gamification concerning its perceived opportunities as well as challenges?

RQ 2: What is required, according to the teachers, to design and use gamification as an additional teaching strategy themselves?

2 Background and Literature

2.1 The Swedish School Context and Digitalization

Rapid worldwide technological and societal changes are imposing new demands on what students should learn in school. Such changes also require schools and teachers to develop student competencies beyond the "basics" in preparing them for the future regarding generic skills and the abilities to collaborate, reason critically, communicate, solve complex problems, and use digital tools (i.e., 21st-century skills). Particularly because research and technological know-how are expanding in society, new opportunities are emerging, and more societal challenges are developing. Research shows that today's fast-paced technological development is exerting great impacts on society, which makes it necessary to be able to think creatively, collaborate, solve problems together with others, and take advantage of the opportunities that digital technologies open up [23] [24] [25]. This applies not only to schools but also to the labour market and everyday life.

One-to-one computing initiatives such as one laptop or tablet per child have become tremendously more common worldwide, not only in Sweden [26] [27]. This trend is observable in many countries regardless of their economic circumstances [28]. For example, Sweden has one-to-one initiatives in almost all of its municipalities [7]. Another challenge for Swedish teachers concerns the recently implemented national digitalisation strategy for the development of adequate digital student competence [29]. One of the challenges teachers express is how to interpret what *adequate* digital competence really means and then how to operationalise this in the classroom, especially given that the digitalisation strategy itself does not define "adequate". Koehler et al. [30] argued that teaching in a technology-rich school environment requires an interweaving of specialised technology, pedagogy, and

content knowledge (TPACK). Furthermore, they argued that teaching using technology in school is an ill-structured discipline. They claimed that effective teaching using technology depends on flexible access to rich, well-organised, and integrated knowledge from these different domains. Acquiring a new knowledge base and skills concerning how technology can be used effectively in teaching may be perceived as a challenging and time-intensive activity to be fitted into an already busy schedule [30].

Despite the urgent national and global demands mentioned above, Swedish schools show a limited focus on developing these competencies, even though large-scale one-to-one computing initiatives have been implemented in recent years [31] [32]. Mårell-Olsson and Bergström [33] found principals to argue that their motives for the one-to-one computing initiatives are to provide a potential opportunity for organisational change and that their primary focus and endeavour is to improve their school's rankings because doing so brings advantageous financial effects. In the study, the researchers showed that the principals were, so to speak, setting the scene for the one-to-one computing initiatives and were laying the foundation for the teachers' work with digital technologies [33]. The curriculum becomes an important part of the teaching design when teaching practices are digitalised and teachers begin to exclude textbooks and instead include an array of both digital and physical learning resources [31]. This study also showed that some teachers emphasise organisational aspects and forget about content, while others intertwine criteria from the national curriculum with the content of study to a greater extent. Thus, considerable variation exists in Swedish schools. Regarding learning approaches, Håkansson Lindqvist [34] found, for example, an emphasis on individual work, while Andersson et al. [35] found more emphasis on group work and cooperative learning. Player-Koro and Tallvid [36] found that the assessment system had a greater impact on teachers' teaching designs concerning how lessons were structured than the digitalisation of teaching itself did. Tallvid [28] and Håkansson Lindqvist [34] found that overall school digitalisation and large-scale, one-to-one computing initiatives in Sweden are not without problems. For example, 10–20% of devices broke down in the first year, and teachers and parents complained about students playing too much or being distracted by these devices. Research has also shown that teaching designs in Sweden [37] [31] [32] [33] [38] and in Denmark [20] mostly are organised through teacher-centred instruction, which promotes student-centred learning activities only to a limited extent aimed at developing students' abilities to collaborate, reason critically, communicate, and solve complex problems when using digital tools in teaching and learning (e.g. often referred to as 21st-century skills—see [39] [40]).

2.2 Learning Expeditions as a Learning Approach

However, McLuhan [41] discussed the effects of societal digitalisation on education as early as the 1960s as follows: "Education must shift from instruction, from imposing of stencils to discovery—to probing and exploration and to the recognition of the language of forms" (p. 100). In line with McLuhan [41], Jahnke [42] stressed the importance of creating more of what is referred to as learning walk-throughs or

learning expeditions for students. Such a learning approach involves student self-reflection and the fact that they make autonomous, independent decisions during learning processes. A learning expedition could be characterised as reflective interactions using open-ended, problem-based learning paths that contribute to goal- or object-oriented learning [43]. They further explained that this means learners could be allowed to choose the necessary instruments or resources to master X or to explore and understand the implications of Y. Jahnke [42] argued that a teaching approach such as *a learning expedition* using contemporary technology fosters engagement, curiosity, and motivation for student knowledge acquisition and multiperspective thinking. In addition, learning expeditions and creative teaching designs are closely related to learner-centeredness, autonomy, playfulness, and the creation of new artefacts [42]. Jahnke et al. [44] found that teachers integrated elements of teaching, learning, assessment, roles, and technologies in different ways in their 1:1 tablet classrooms. In these classrooms, in which teaching could be defined as creating a learning expedition for student learning experiences, teachers created learning opportunities that could be described as moving away from course-based learning. This type of teaching includes learning goals for which more than one answer is correct; teaching designs focused on learning as a process; teaching designs that encourage students to experiment, play, and explore topics; and assignments that allow students to choose how to make their learning visible [45]. In addition, the teachers also supported students in creating products such as digital paintings, digital stories, comics, movies, and podcasts. However, Jahnke et al. [44] argued that use of tablets in some classrooms in the study unsurprisingly focused more on supporting surface learning than on enhancing deeper learning. In some classrooms, applied teaching designs sometimes even limited the opportunities for learning to take place.

In line with Jahnke et al. [44] and Jahnke and Norberg [43], Jonassen et al. [40] also claimed that student use of technology in learning may benefit students' learning processes when technology is used for complex problem-solving and information-retrieving purposes. However, they further argued that in order to teach with technology effectively, the teaching design must shift from traditional instructional practices to a more constructivist approach based on student-centred learning in order to achieve what they termed meaningful learning [40]. Jonassen [39] argued that students only learn properly when they construct knowledge, think, and learn through experience. However, Kim et al. [46] found that teachers' own beliefs influenced their technology-integration practices, and Ejsing-Duun and Skovbjerg [47] showed that students' ability to gain from open-ended learning processes is limited by teachers' often fairly traditional understanding of creativity and innovation in teaching design. Furthermore, Kim et al. [46] argued that teacher behaviour does not change without changes in beliefs and that teachers need proper support to increase their technological integration and adoption of new teaching designs.

Games and gaming exert an enormous impact on the youth of today. Game designer McGonical [48] stated that 21st-century young people will spend over 10,000 hours on digital games before they are 21 years old. In 2015, teenagers (13–18 years old) in the United States spent 9 hr consuming entertainment media, on average, of which 81 minutes was spent on playing computer games [49]. Statens Medieråd [50] conducted a study into youth and media in 2017 and found that 99% percent of Swedish teenagers had access to a smartphone, 86% of 9- to 12-year-olds used their

smartphones to play computer games and, 38% played every day. However, there is a gender difference. The difference in gaming was greatest among 13–16-year-olds, in that 47% of boys played every day, compared to only 4% of girls [50]. Furthermore, in another study by Statens Medieråd concerning young children's media habits, the parents answered that 58% of their 2- to 4-year-olds played games and that 80% of children aged 5–8 years old mostly used smartphones or media tablets when gaming. In addition, 51% of 8-year-olds gamed every day in some way. Hence, gaming exerts an enormous impact on the everyday life of modern children and youngsters. Yet, how this increasing trend affects teachers' readiness to use, for example, gamification in teaching for fostering students' 21st-century skills in combination with contemporary and emergent technologies has barely been researched.

Moreover, game developers try hard to create games that promote player involvement and encourage them to continue levelling up. According to Statens Medieråd [50], online gaming activity is increasing year after year and is moving to younger age groups in Sweden. The player experience includes five planes: motivation, meaningful choices, balance, usability, and aesthetics [8]. Thus, game mechanics are methods invoked by agents and designed for interaction with the game state [51]. Hence, the strategy is to develop a game that creates an inner drive among players addressing their motivation and commitment. These *driving forces* [11] motivate a player to keep moving forward (e.g., to level up). Pintrich and Schunk [52] (p. 4) defined this motivation as "the process whereby goal-directed activity is instigated and sustained". Moreover, Jakobsson [53] described motivation in an educational context overall as an aspect of how students value a given task and what they want to achieve. Consequently, confidence in one's own ability to cope with the task as well as the kinds of control one has over the learning situation are crucial for creating motivation. Gage and Berliner [54] described motivation as a sustained strategy aimed at reaching a specific goal and maintaining interest in continuing with what one is doing at the moment. Research shows that using computers and tablets in schools has some positive effects on student motivation to learn, even if traditional teaching designs are used [55] [56]. On the other hand, a perceived feeling of carrying out a meaningless task or assignment, even if computers or tablets are used, may decrease motivation for schoolwork [39]. Research also shows that teachers continuously seek new, promising instructional approaches because modern schools face major problems concerning student motivation and engagement in their learning processes [57].

2.3 Gamification as a Teaching Strategy

Using gamification as a teaching strategy in education (e.g., designing school content and activities to reach the same motivational engagement as in games) promotes and increases students' desire to learn and increases their academic performance. Sailer et al. [58] defined gamification as the process of making activities in non-game context more game-like by using game design elements. Consequently, the idea is to recreate motivation similar to the strong motivation created by games for learning situations in schools. When designing gamification activities for school or higher education, the

purpose is for the students to achieve what Csíkszentmihályi [59] described as a "flow experience", This means that a student is fully immersed in a feeling of energised focus and is full of involvement, engagement, and enjoyment in the learning process when performing a task. The "flow" is a factor that guides every type of well-developed gaming experience, and when a student performs a task or assignment at school, this activity must have a complexity level that requires a certain skill level [60]. As mentioned in the introduction, Chou's [11] Octalysis framework consists of eight core drives to be considered when designing for gamification activities (i.e., game design elements), divided into positive, negative, emotional, and physical driving forces. The positive driving forces are accomplishment, meaning, and empowerment; the negative forces are scarcity, avoidance, and unpredictability; the emotional driving forces are empowerment, social influence, and unpredictability; and the physical driving forces are accomplishment, ownership, and scarcity.

Hence, using gamification in teaching, by building gaming experiences into the design of ordinary teaching modules, is aimed at taking advantage of these motivational dynamics to facilitate the inner "flow experience" among students and to provide them with the preconditions for reaching this state when solving the assignments. One example aimed at reaching this gaming experience is to create problem-solving challenges that leads to clues to solve and to new problem-solving challenges within the specific subject or content (similar to levelling-up in games; see, for example, [21] [17] [18]. However, the actual effects on academic performance as well as what teachers perceive as challenging barely have been researched [60] [5]. Nevertheless, the studies available on this topic show that the effects are greatly dependent on the context and the teaching designs in which the gamification activities are implemented as well as on the users [61] [5] [62].

De-Marcos et al. [63] found that a traditional e-learning approach was more effective in assessing knowledge than a gamified approach was when comparing social networking and gamification. However, Zweirs et al. [64] argued that gamification can assist students in developing intrinsic motivation by establishing a meaningful and engaging social environment in which students can explore and innovate. In addition, Appleton et al. [65] stated that extremely motivational teaching strategies and pedagogical methods, like gamification, show a direct correlation with improved academic engagement and positive learning outcomes. Dicheva et al. [12] found that combining both extrinsic and the intrinsic motivators can produce greater student production and increase engagement. However, they showed that teachers continuously struggle to identify what really motivates students to gain success in their academic performance. In line with this, Sanmugam et al. [66] stressed gamification must be designed systematically and in an orderly manner to ensure what they called a successful injection into education. Furthermore, they argued that the results cannot be assumed to be an instant success. The aspects of mastery will exist if the users can become immersed in the gamification activity and, hence, are willing to repeat the allocated tasks.

2.4 The Importance of Feedback

In both games and gamification activities, instant feedback on performance (for example, points, badges, or valuable clues for the next problem-solving challenge) while "playing" is important for students to be willing to continue and solve the assignment [61] [11]. Chou [11] described one of the core drives in the Octalysis framework, empowerment of creativity and feedback, as being the drive that most people refer to as "play" (points, badges, etc.). Furthermore, Chou argued that this core drive emphasises the vital intrinsic motivation. Compared to games, in which playing generally has no real purpose beyond just having fun, the gamification activity has a purpose to it, and even if users might perceive it as boring, they still have a reason to stay [11]. Moreover, Sadler [67] described feedback to students on their performance as important and how providing information related to the task is necessary for generating positive effects on learning, to fill the gap between what the students understood and what is supposed to be understood regarding a specific subject. Hattie and Timperley [68] conceptualized feedback in educational settings as "information provided by an agent (e.g., teacher, peer, book, parent, self, experience) regarding aspects of one's performance or understanding" (p. 81). Furthermore, they stated that feedback thus is a consequence of performance and clearly can be a powerful tool for increasing learning but that some types of feedback are more powerful than others are. Thus, providing students with information feedback on tasks and how to do them is more effective than only providing praise, rewards, or punishment for performance as feedback. In addition, extrinsic awards, praise, and punishment were least effective in enhancing student achievement [68].

On the other hand, regarding student motivation, Attali et al. [61] explained that even simple game-like elements in teaching, such as points or badges, can provide some information about students' success in performing a task that may motivate students to continue working. Deci et al. [69] argued that rewards such as points, stickers, or awards could be seen more as contingencies to activities than as feedback on performance because such rewards contain little task information. Furthermore, they argued that extrinsic awards could be perceived as negative because the awards could undermine student responsibility for motivating and regulating themselves. This might be in line with Chou's [11] argument that the core drive of empowering creativity and feedback might be the most difficult to implement correctly in gamification activities. Although research appears to show that gamification teaching designs are effective overall in motivating and engaging students in schoolwork, Landers and Armstrong [62] demonstrated that students with poor attitudes and limited experience with these types of teaching strategies may prefer traditional teaching to gamification teaching designs. Thom et al. [70] removed "points" from an enterprise social network system (i.e., a key game element related to gamification) and found a negative impact on user activity after doing so. They believed that withdrawing points from an existing system, for example, could affect user motivation negatively. Zichermann [71] also highlighted this, stating that external motivators cannot be cancelled if users are used to them. Hence, gamification teaching designs may improve learning outcomes and can lead to overall higher

performance, but the effects may not be as originally intended if teachers use them as a trendy design approach or as a design just to make teaching fun [62].

2.5 Increased Inner Motivation Through Gamification

Johnson et al. [72] examined technology trends and challenges in Scandinavian schools and stated that gamification as a teaching design is expected to have significant impacts on educational work within 3 years. Several other recent reports have also predicted the same trend. Nevertheless, not much has happened in schools, at least not in K–12 education in Sweden. However, students certainly are *not* a homogenous group, and using the same approach to create a gamification experience might not be effective for everyone [60]. For example, Bartle [73] found four personality types in virtual game environments: *achievers*, who try to master everything there is to do; *explorers*, who are not particularly focused on overcoming challenges but want to explore all the content there is to explore; *socializers*, who really want to interact with one another and have conversations and build relationships; and finally *killers*, who strive for glory by reaching the top and beating down the competition in the process. Hence, because gaming is common among youngsters, designing gamification activities in schools with respect to different personality types and increasing the use of multimodal functionalities with contemporary and emergent technologies could be one way of increasing variation and motivation among all students. Even if research shows that gamification could improve students' inner motivation to learn in school, many questions still exist as to why teachers do not use gamification as a teaching strategy to a greater extent. Why is that? Why are teachers not approaching gamification as a teaching strategy even though it is aimed at increasing student motivation and, in turn, at possibly increasing their academic performance? First, is this true? Secondly, if so, what are the perceived "problems"?

3 Materials and Methods

3.1 Theoretical Framework

The theoretical framework of this study is based on activity theory, in which motives, goals, actions, and operations are key starting points [74]. Activity theory embraces an exploration and an understanding of a context in relation to how social relations and materials, tools, and intentions affect people's actions in different situations. Within activity theory, it is important to study the role a given artefact or tool plays in everyday life [75]—for example, using gamification in teaching with the support of contemporary and emerging digital technologies. Leontiev [74] included not only the individual's actions, but also group actions within a social system. Hence, the individual is in focus (i.e., the teacher in this study), but is understood in relation to an

activity system (in this study, the context of gamification activities). Using activity theory as a theoretical framework helps to make sense of a context, and specifically the interplay between social relations, materials, tools, and expressed motives in a situation (i.e., operationalisation of the gamification activities in the classroom). Activity theory also supports the understanding of the role of the artefact—in this case, the use of contemporary and emergent technologies in teaching activities—within the activity system [75]. Leontiev [74] described an *activity* as a system that includes elements of motive, goals, actions, and operations (see Figure 1). Further, he explained that teachers carry out operations in the classroom (i.e., teaching). These operations could be, for example, different routines and procedures. These are, in turn, related to preconditions within the school organization. The practical examples teachers use in the classroom are made up of combined actions. These actions are related to a goal a teacher is trying to achieve (see Fig. 1).

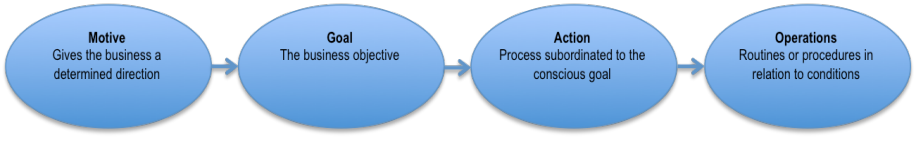

Fig. 1. Key Concepts Within an Activity System. Adapted from *Verksamhet, medvetande, personlighet*, by A. N. Leontiev, 1986. Copyright 1986 by Progress.

The study included four substudies and was analysed as four activity systems within a larger activity system (the full study). Thus, activity theory was used as an overall framework in combination with aspects of design-based research methods [76]. More explicitly, activity theory framed the overall study in different levels concerning the motive of exploring opportunities and challenges teachers perceive in designing gamification in K–12 education. The overall goal was to develop different examples of gamification activities within each participating teacher's subject. This was done so teachers could foster their own critical reflections and expand their experiences of using gamification in teaching. Actions concerned design processes regarding using the university students as cocreators [17] in designing the gamification activities. Teachers were used as experts of their chosen topics within the four activity systems, as well. Finally, the gamification activities within each substudy were tested by students. Thus, the four different designs concerned the concept of operationalisation. In addition, within each of the four substudies (seen as four activity systems), the concept of motive concerned the specific purpose of each substudy regarding what the students should learn within the topics chosen by their teachers. The goal within these four activity systems concerned gamification design, focusing on developing students' 21st-century skills and the use of emergent technologies. The operations within the four activity systems concerned the younger students' tests of the university students' gamification designs. In addition, this exploratory study was inspired by and included aspects of design-based research methods [76].

3.2 Study Context and Participants

As mentioned above, earlier studies [21] [17] [18] [22] found that teachers possess limited knowledge of what gamification in teaching could mean for them, and how to plan and design their own teaching using gamification. Hence, teachers who use gamification are hard to find in Swedish schools. To study teacher perception for using gamification in educational settings, as well as the entire process from the first idea to the teaching design, then to actual operationalisation in the classroom, it was decided to conduct a study inspired by design-based research methods [76], by cooperating with a mandatory course given within two masters of science programmes for engineering students at Umeå University. The purpose for collaborating with the university students to design the gamification activities for students in K–12 education, was first to study their design process, and second, to use their creativity and technological competence to develop examples of gamification activities in a school context. This, to go beyond traditional classroom teaching (i.e., "think outside the box"). The idea was that teachers would be able to experience an example of a gamification activity that went beyond their ordinary teaching methods in their subjects; in addition, the teachers could describe and reflect on the opportunities and challenges they perceived with gamification in teaching.

Because the study focuses on teachers' perceived opportunities and challenges by giving them examples of gamification teaching designs, it was decided not to involve them in the design process of activities, but more as experts on the chosen topic. Further, the participating university students were taking part in a mandatory course on planning and organising work in a project within the masters of science in engineering physics and industrial engineering and management degree programmes, and were selected for the project by their teachers. Within the study, the university students could be described as cocreators (see, for example, [17]).

Four sub-studies were conducted between 2014 and 2018. In each sub-study, six university students worked together as a mixed group—three students from the masters of science in engineering physics, and three students from the masters of science in industrial engineering and management programmes. One group of six students participated each year in 2014, 2015, 2016, and 2018, for a total of 24 university students throughout the entire research project.

By applying purposeful sampling [77], participating schools were selected for the study based on the conditions of providing one-to-one computing initiatives for their students and possessing experience of teaching using technology. The principals at each school were contacted, who in turn asked teachers whether anyone was interested in participating in the study. Four teachers reported their interest and agreed to participate. One male secondary schoolteacher participated in Sub-study 2, one female secondary school teacher in Sub-study 3, and two upper-secondary schoolteachers in Sub-study 4. In the field tests, two students aged 14 and 15 participated in Sub-study 1, twenty-six 14-year-old students in Grade 7 participated in Sub-study 2, an eighth-grade school class of 15-year-old students ($n = 24$) participated in Sub-study 3, and 25 11th-grade students (mostly aged 18) participated in Sub-study 4. All participants agreed to a statement of research ethics based on beneficence, nonmalfeasance, informed consent, and confidentiality [78].

3.3 Materials

For the entire research study, including all four substudies, a qualitative approach was taken in order to investigate and expand the understanding of teachers' perception to develop these types of activities as an additional teaching strategy. The empirical material was collected through observations with written field notes during the tests/gamification activities with the students (the four substudies) and semistructured interviews with teachers. The students' experiences were observed, how they perceived the actual tests, and their reactions during the gamification activities. Discussions were held with them during the tests, as well. After each activity, the students gathered to express their reflections on the opportunities and challenges they experienced.

Semi structured interviews with the teachers focused on how they discussed using gamification in teaching and their reflections concerning how this might affect student learning (or not affect it). For example, by asking open questions such as "What opportunities or challenges do gamification offer?" "What pedagogical opportunities and challenges are present concerning student knowledge acquisition and learning?" or "What is required for you to use gamification as a teaching strategy?" Each interview lasted around 60 min, and interviews were transcribed verbatim.

To construct an understanding and a meaning of the collected empirical material, thematic analysis [79] was used to identify key themes and emerging patterns. Thematic analysis can be described as a process of encoding qualitative information, and is used to assist researchers in their search for insight [80]. Boyatzis [80] described the process as including two perspectives: "seeing" and "seeing as." Creswell [81] explained "seeing as" as searching for repetitive patterns of meaning (i.e., significance) in qualitative data. The process of thematic analysis includes several readings within iterative processes in order to identify emerging patterns. The different steps include (a) reduction of the data (coding), (b) presentation of the data (thematisation), and (c) summation of data in the form of conclusions and verification. Ely [79] described a *developed theme* as a definition either of utterances that all informants in a study express, or as a single statement of an opinion that has great emotional or actual significance.

To analyse the collected empirical material, NVivo was used to code and categorise the data (i.e., a qualitative data analysis computer software). The steps of the analysis process concerns constructing meaning or "seeing as" by searching for signs and patterns in both the written observation notes and participant utterances regarding what they explicitly or implicitly stated during interviews. For example, how the teachers described the pedagogical opportunities gamification might offer and what they want to achieve with their own teaching concerning student knowledge acquisition and learning processes. First, these types of utterances were coded and categorised as expressed motives and goals. In addition, what the teachers described as necessary for them to be able to use gamification as a teaching strategy (e.g., reflections on opportunities and challenges) were coded and categorised as actions and operationalisations. Further, in several iterative processes, categories indicating similar types of expressed motives, goals, actions, and operationalisations were then

clustered. As a final step, the clustered categories were analysed to form the emerging themes presented in the Findings section.

3.4 Study Design

In all four sub-studies, the groups of university students were given almost the same task: to develop a gamification teaching activity for students including contemporary and emergent technologies in the design. It was only the content (the subjects taught by the participating teachers) that differed among sub-studies (see Fig. 2). However, the four sub-studies could be characterised as constructing four practical examples of gamification teaching designs in combination with the use of contemporary and emergent technologies. The researcher provided an open situation (a school environment) for each sub-study, and supported the university students along the way. The university student groups were also supported by the relevant teachers participating in the sub-studies, as experts on the chosen topics.

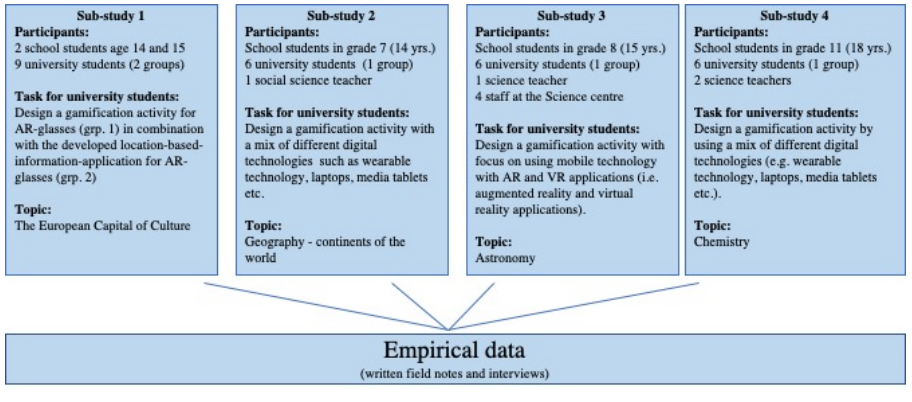

Fig. 2. Overall Study Design

3.5 Procedure

The Octalysis Framework, and Game Mechanics and Dynamics in Gamification Design. In all four sub-studies, the university students were introduced to the Octalysis framework [11] to support the use of game mechanics and game dynamics in their gamification designs (see Fig. 3). This facilitated the university students' creativity and supported the design process by addressing the core drives in the activities. This was done specifically to foster the participants' inner drive—to motivate them and engage them to perform their best when solving the different problems or challenges presented in each sub-study.

In addition, the university student groups in each sub-study were also tasked to design their activity to foster students' 21st-century skills (i.e., collaboration, critical

reasoning, communication, and complex problem-solving), and to use contemporary and emergent technologies. Thus, all university student groups started with an idea-generating phase using the Octalysis framework as a basis, then combined the framework with the teachers' chosen topics for the activities. Each university student group developed their own concept and designed different gamification activities, trying to reach each core drive in the Octalysis framework. Teachers acted as experts on the chosen topics and gave the university students feedback on how they designed the different tasks in each gamification activity. For example, the teachers gave the university student groups feedback on the knowledge level, so it would not be too hard or too simple for students to solve the presented problems in the gamification activities.

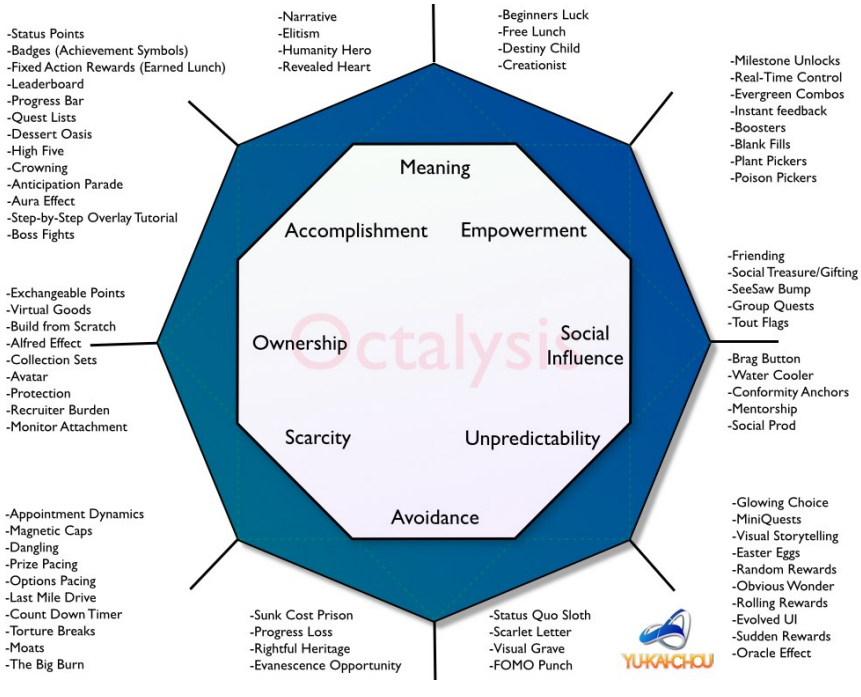

Fig. 3. Octalysis Framework and Gamification Design [11].

Sub-study 1. The first sub-study was conducted in 2014. Its aim was to investigate how to combine the use of a single emergent technology (Augmented Reality glasses) with the emergent teaching practice of gamification. Sub-study 1 was conducted in spring of 2014, and nine university students divided into two groups participated. In addition, two students aged 14 and 15 participated. One of the university student groups (Group 1, $n = 3$ students) were given the task of developing an application for smart glasses (Google Glass) using location-based information. The second group (Group 2, $n = 6$ students) were given the task of integrating the location-based information application developed by Group 1 into a gamification activity for the two

participating secondary school students to test. Group 2's task also required developing problems or challenges for the gamification activity in which the two students would be able to collaborate, reason critically, communicate, and solve complex problems (21st-century skills). A cultural theme was chosen as the topic for the gamification activity, as the city of Umeå was chosen as the European Capital of Culture in 2014. Data collection consisted of observations and written field notes during the test of the gamification activity.

Fig. 4. Sub-study 1 - Problem Example.

Fig. 5. Participants Wearing Google Glasses. Note. Here, the two students discussed the pieces of information they got and what strategy to use to solve the clue.

Group 2 chose to design their gamification activity as a type of a treasure hunt. The activity was designed to consist of multiple problems the students had to solve sequentially. The students had to solve problems (see Figure 4 for an example) at one level before continuing to the next level, similar to levelling up in gaming. Due to limited access to the smart glasses (Google Glasses), only two students participated in this substudy. During the game, the two students had to collaborate in each presented problem. This meant that they had to put pieces of information together by collaborating and discuss the correct result to solve a given problem before getting the clue for the next level, similar to solving a puzzle of information (see Fig. 4 and 5).

Sub-study 2. The second sub-study was conducted in 2015, and a second group of university students participated. This university student group were also given the task of developing a gamification activity, but instead of using only a single technology (the AR glasses), they were given the task of using a mix of different digital technologies (e.g., wearable technology, laptops, media tablets) in their gamification design. In this second sub-study, six university students, one schoolteacher, and twenty-six 14-year-old students in Grade 7 participated. The participating schoolteacher taught social science. The topic chosen by the teacher was a teaching module in geography, namely continents around the world. Thus, the task for the university students was to focus on developing problems for which the students would work in groups to develop 21st-century skills using a mix of different digital technologies.

Fig. 6. Participant-Designed Station System, Sub-study 2.

This group of university students also designed their gamification activity as a type of a treasure hunt. This gamification activity was designed as a station system in which the students worked in groups and responded to a number of issues related to a

specific continent in order to gather clues. At each station, different types of technology were used in the form of Google Glasses, virtual games, or video or audio clips. Clues collected by the student groups during the game, were supposed to be used at the end to solve a final problem, which resulted in a specific geographic location (see Fig. 6). During the test, each group of students used a tablet to record answers to the problems given at each station. Data collection consisted of observations and written field notes during the gamification activity test, and a post interview with the participating teacher.

Sub-study 3. The third sub-study was conducted in 2016 with a third group of university students. This group of university students were also given the task of developing a gamification teaching activity. However, this time they had to focus more on using emergent technology with AR and VR applications. Participants in the third sub-study consisted of six university students, one upper secondary schoolteacher, a class of 15-year-old eighth-grade students (n = 24), and the teaching staff at a local science centre where the actual test was held. Because the teachers at the science centre and the secondary schoolteacher wanted to develop their teaching in the subject of astronomy and on how to use digital technologies in teaching design, the university students were given astronomy as the topic for the gamification activity. Data collection consisted of observations and written field notes during the test of the gamification activity and a post interview with the participating teacher.

This group of university students designed their gamification activity in four parts, like a station system. The parts or stations were (a) planets in space, (b) the International Space Station, (c) landing on the planet Mars, and (d) gravity.

Their design also included a final quiz on which the eighth-grade student groups had to answer questions (i.e., solve problems) based on all four stations. At each station, points were awarded according to the groups' achievement. During the game, participants could follow the scores of each group on a large screen as a live scoreboard. In addition, the university students in Sub-study 3 developed a general framework for teachers to use when designing their teaching as a gamification activity (see an example in Fig. 7), with a description and suggestions of different steps in the design process (e.g., how to think).

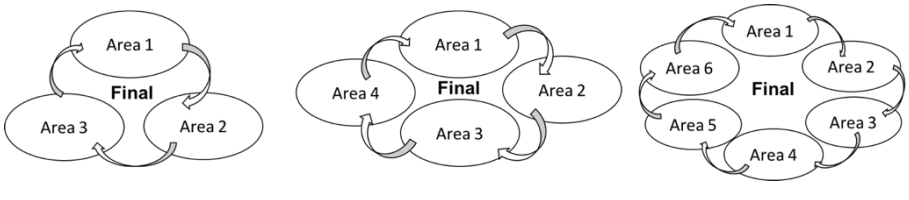

Fig. 7. General Framework and Numbers of Stations, Sub-study 3.

Sub-study 4. The fourth sub-study was conducted during the spring of 2018. This group of university students were given the same task as the earlier groups: to develop a gamification teaching activity for students. This time, the topic chosen was chemistry, as the two schoolteachers who participated were chemistry teachers. As in sub-study 2, the university students had the task of developing a gamification teaching

design using a mix of different digital technologies (e.g., wearable technology, laptops, media tablets, smart glasses). In the sub-study 4, six university students, two chemistry schoolteachers, and 25 11th-grade students (mostly age 18) participated. A specific topic was chosen from organic chemistry: genetic information flow and the metabolism, structure, and function of enzymes and proteins. As in the earlier sub-studies 1–3, the task for this fourth group of university students was to develop problems on which the upper-secondary students would be able to work in groups to collaborate, reason critically, communicate, and solve complex problems. Data collection consisted of observations and written field notes during the gamification activity test and post interviews with the two participating teachers.

This group of university students developed a gamification activity consisting of six stations featuring different planned activities as (a) viewing a film and answering questions, (b) a quiz, (c) another quiz, (d) a Pictionary-like game in which student groups had to draw a word connected to the subject and the rest of the group were to guess the correct word, (e) a problem where student groups had to find different elements using VR goggles and VR applications for smartphones, and (f) a problem where student groups had to use AR glasses (e.g., Microsoft HoloLens) to see molecules in 3D (see Figure 8). Groups were awarded points at each station based on how successful they were and how they solved each problem. The student groups completed one station at a time, and their points from each station were then merged into a single result in the end of the game.

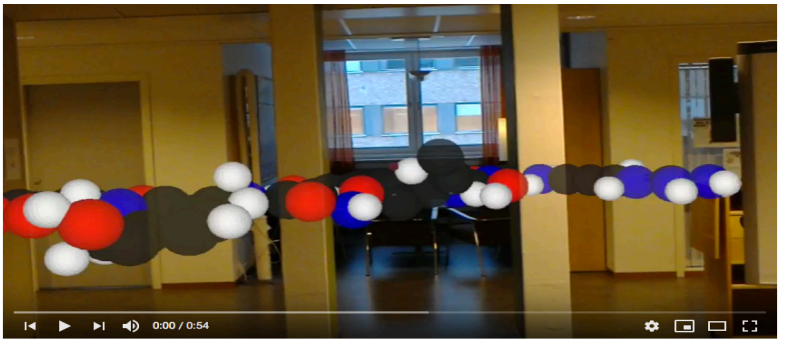

Fig. 8. 3D Molecule Projected by Augmented Reality Glasses. Note. Microsoft HoloLens was used for this image.

4 Findings

The findings are presented in three themes: first, fostering motivation and collaboration, which concerns students' reflections on the gamification activities and second, pedagogical balance is necessary to achieve deeper learning. This idea concerns teachers' experiences and reflections of using gamification in teaching. The latter theme illustrates how the participating teachers described gamification and their reflections on what opportunities and challenges there were to designing gamified

teaching activities in school. The third theme concerns organisational changes regarding time and collaboration in teacher teams. The quotations presented in this section should not be regarded as evidence, but more as illustrations of the themes that emerged during the empirical material analysis process.

4.1 Fostering Motivation and Collaboration

All the students in all four substudies enjoyed the gamification teaching designs. During the tests, all the student groups laughed a lot and discussed how to solve the problems often in loud voices and with excited gestures to convince other group members of the correct answers or results. They also stated at the meeting after the test was finished, that they liked the test very much when describing how they perceived the gamification activity. The students also expressed that they thought it was fun and entertaining and wished they could have more activities such as this in school. In Substudy 1, the girl taking part said afterwards, "This has been the best school day in my life. Every school day should be as much fun as this one." The teachers also expressed that they enjoyed it. For example, the teacher in Substudy 2 explained, "It was great fun to see how they [the university students] used the digital tools and the opportunities they open up."

According to observation notes, the students showed great enthusiasm when discussing with each other during the activities, and they were all eager to solve all the problems the university students had provided for them. During the entire activity, the students stayed focused and collaborated. A strategy all the student groups used during the game was to figure out each individual member's specific skills and knowledge by discussing and deciding which one in the group would solve a problem the best, particularly at the stations that only required one group participant to do something. This was a repeating pattern in all four substudies. The student groups demonstrated a strong focus on collaboration and on winning the game.

The criteria given to the university students were to focus on the development of generic skills and abilities such as collaboration, reasoning critically, communicating, solving complex problems, and using digital tools (i.e., 21st-century skills). In all four sub-studies, the students truly had to use their 21st-century skills in every task they were given.

4.2 Pedagogical Balance is Necessary to Achieve Deeper Learning

All participating teachers said that they believed that gamified teaching designs could be a good way of motivating students to do their schoolwork to a greater extent. Additionally, teacher stated that students could acquire knowledge at the same time without focusing on their own learning process. However, according to the teachers, this requires that the gamification activity be well designed and consist of both fun elements and elements that trigger learning processes in students. One teacher described this by saying, "I think it is very good that they play and learn without really realising what they are doing."

Another teacher explained: "The students like it very much and think it is fun. If you [as a teacher] find good stuff to use, motivation will come automatically. It will be more fun for them [students] just by using things like Socrative [an application where it is possible to launch a quiz, receive exit tickets or ask a quick question for instant student feedback] so they can compete. Those who succeed in winning—and that is after all a strong driving force—and if you can then do it in a way they get knowledge and learn at the same time, it's for free. That is really good. You know, things that you are interested in are so much easier to learn than if you, you know, were to sit and read a boring text just because you have to read it. In this way, they can learn without having to make any significant effort."

Even if all the teachers described gamified teaching designs as a suitable strategy to motivate students, they also stressed that there is a great necessity for what could be termed *pedagogical balance*. This idea describes a design that balances between finding and designing fun elements in relation to knowledge elements that trigger school student knowledge acquisition and learning processes. Finding the right pedagogical balance refers to a design where a teacher is able to create balance between just having fun and one in which the students also acquire knowledge at the same time. The teacher in Sub-study 2 explained, "It was so good that during the activity, they [the students] could also practice problem-solving skills in a fun way. They had to think, collaborate and in that way solve the problems." Another teacher confirmed this: "It is more fun for [the students] when the teaching design is more varied compared to just traditional teaching. However, it [the teaching design] should not just be gamified for fun. They [the students] have to learn something, too."

In Sub-study 4, the teacher felt that it could be hard to create this pedagogical balance: "There is a risk that there will be too much focus on the fun. This driving force is important, but there is also a risk of losing . . . there is a risk that the fun takes over. The fun could take over. In our activity, my students kind of never have had such fun, but as a teacher I felt, "hmm . . . not so much new knowledge and learning here at this particular station."

The teachers participating in this study explicitly stated that gamification activities could motivate students to a great extent, and that it was possible for them to practice problem-solving skills in a fun way and use different students' skills in turn in the collaborative elements. According to the teachers, well-designed gamification activities could thus make it possible to achieve deeper learning. However, they all agreed that identifying and designing activities to achieve this pedagogical balance is a real challenge. One teacher described it by saying, "It depends on how strategic you are in your design. As a teacher, you really need to think hard about how to create variation and balance and all that."

Pedagogical balance does not only refer to finding a balance between fun and designing for deeper learning (e.g., practicing problem-solving skills). It also concerns how to use a teaching design where all the students are kept in mind in order to fulfil all their specific needs. One teacher explained, "You have to reach all the students. Some of the students might need more time to discuss a solution than others. It is very important to have all your students in the class in mind when designing for this."

Another skill the teachers mentioned concerns knowing enough about games and how gaming works. A teacher in Substudy 4 explained that she really needed competence development to understand how gamification works:

I have played too little myself. Creating a memory? Okay, that's fine; but figuring out a challenge for the students to solve on one level and trying to connect it to a challenge on the next level so they can solve the main problem in the end—closing the loop, so to speak—that's not possible for me.

4.3 Organisational Changes Regarding Time and Collaboration in Teacher Teams

Finding enough time to create a well-designed gamification module is also something that all of the teachers mentioned as a crucial factor. The teachers stated that they need time not only for competence development about the core object of gamification but also with their colleagues to be able to create a design with them. "It has to be well designed and carefully thought out. I guess that is something that many teachers don't have time for. We don't have time to think and create it and to search for good materials. We don't have the skills and time to create it [a design] ourselves. I need to collaborate with someone."

Another teacher explained: "We then need less teaching time in class to manage to do it. I would also like to have access to a kind of database where I can find different solutions to pick from and get inspired in order to save planning time, especially concerning whether I could do it together with colleagues; it would be so much easier. If I have to do it just by myself, it will never happen, I'm afraid. I guess our principal needs to organise it for us as well. Giving us the time and the preconditions for really being able to mange to do it. Otherwise, it will never happen, because we will start thinking, No, no, this is too hard and time consuming."

Furthermore, the participating teachers stated that designing for gamification teaching activities and finding the pedagogical balance within this context is a complex process and requires a mix of different knowledge and skills (i.e., time, game experience, what students think is fun, and enough knowledge about each student's specific needs). The pedagogical balance could thus be described as combining the necessary knowledge and skills in a certain way within every specific activity or challenge and evaluating the specific added value within this special combination. Being strategic when designing for gamification to achieve deeper learning, as one teacher called it, could be interpreted as a highly complex process and is perceived as a real challenge.

In summary, one possible interpretation is that the design the university students created when combining the game mechanics and game dynamics to relate to the chosen topic actually does activate and foster school students' motivation to solve the given problem by any means possible. Another possible interpretation is that the use of game mechanics and game dynamics in these gamification activities, such as the collaborative student-group treasure hunt presented in Substudies 1–4, fosters collaboration among students to a considerable extent if the activity is well designed. This means reaching or meeting all of the criteria from the knowledge level to the students' school level (i.e., content), considering the different opportunities each

digital technology offers (i.e., technological knowledge), considering how to use game mechanics and game dynamics, and incorporating 21st-century skills in the design of the specific activities. In addition, all of these considerations in the design must be used in different combinations in relation to each other. A third possible interpretation is that this type of teaching design is quite a complex process to handle and that there are a lot of different aspects to take into consideration when designing gamification activities for school students. This is especially so for a teacher trying to achieve a design that not only uses contemporary and emergent technologies but also combines different elements to foster school students' motivation and engagement (e.g., being perceived as fun) and promote their development of 21st-century skills.

5 Discussion

Although all of the participating teachers described gamification as a catalyst for motivating and engaging school students to do schoolwork while also acquiring knowledge, they also perceived some challenges and obstacles, primarily concerning the lack of time and knowledge about how to design for gamification. The challenges they described are, for example, having enough planning time, especially with their colleagues. However, the most challenging part they described is the actual design process. This concerns being able to achieve a pedagogical balance between just having fun and obtaining deeper learning through the combination of these pedagogical elements and digital technologies. This means possessing enough knowledge about how to design a gamification activity similar to those the engineering students constructed in the four substudies (see also [17]), because these differ from their traditional teaching designs. This could be compared to what Mårell-Olsson [17] found in her study about using university students as cocreators, namely that the lack of knowledge of how a design process could be constructed and what can be interpreted as creative thinking (e.g., using tools for brainstorming and generating new ideas) are crucial factors when designing gamification activities. This concerns being creative when combining the subject content being taught with gaming experiences (e.g., using the driving forces; see [11]) in which school students need to collaborate to foster their problem-solving skills while also including contemporary and emerging technologies that enhance their learning processes and digital competence.

Therefore, digitalised gamification activities in schools are regarded as a complex pedagogical teaching strategy that differs from traditional teaching methods and requires support from school principals. This concerns not only competence development for teachers in this context but also freeing up time and creating the preconditions for collegial learning and collaboration. This could be regarded as being aware of concrete motives and goals on several levels as well as how to achieve them by controlling the operations of the actions [74]. Further, Leontiev [74] argued that humans originally characterised the objects they acquired from the outside world as a means of satisfying their needs and bringing them benefits. However, there is a difference between individuals and how well they adapt to a situation in terms of their

ability to become aware of themselves within an activity system. The same applies to becoming aware of oneself within such a system [74]. In this study, the teachers' descriptions of their readiness is thus described as a complex process. This concerns finding the pedagogical balance aimed at achieving deeper learning when using gamification teaching activities as an additional teaching strategy and acknowledging that an organisational change is necessary to achieve this. These changes could, thus, be regarded as tools for gaining the teachers' satisfaction and developing their needs, which could be conveyed and transformed into the motives for their design processes [74].

When teachers consider integrating new teaching methods and/or new technologies, they face challenges in redesigning their well-known and often-used teaching methods [17] [38]. This will create different opportunities as well as challenges for them when designing teaching and learning in a new context, with new teaching methods and contemporary and emergent technologies. In a Danish study, Ejsing-Duun and Skovbjerg [47] argued that teachers often convey fairly traditional understandings of creativity and innovation in their teaching designs, which limits school students' ability to follow open-ended learning processes. Accordingly, in this study, the participating teachers face challenges that concern how to design for gamification activities with the use of both contemporary and emergent technologies and which teaching designs are useful for increasing students' motivation, improving their knowledge acquisition and learning processes, and fostering their 21st-century skills. The design processes concern how to think and act when redesigning traditional instructional teaching to become more like learning expedition designs [21]. In addition, the teachers in this study stressed that it is important to be aware of and identify what could be termed as a pedagogical balance without sacrificing focus on student knowledge acquisition.

This could also be compared to what Jonassen et al. [40] described as meaningful learning. As a teacher being able to understand and design for a pedagogical balance with digitalised gamification activities, according to one's own beliefs about learning processes, is a complex process (cf. [46]). For the purpose of fostering students' motivation to collaborate and solve assignments (e.g., levelling-up), teachers need not only knowledge about what driving forces are in play [11] but also enough competence in the subject to be taught (content knowledge; [30]). In addition, they need knowledge about what students really perceive as fun and the level for which a problem needs to be designed (not too easy or too hard to solve, i.e., pedagogical knowledge; [30]). Further, when integrating contemporary and emergent technologies into a design, teachers also need to have enough technological know-how [30] to decide which technology should be used in which problem and what value the specific technology adds. All of these different knowledge areas (TPACK; [30]) must also be combined and evaluated at every step when designing for the type of gamification activities presented in this paper. Koehler et al. [30] described these skills as the forward-looking, creative, and open-minded seeking of technology use to advance student learning and understanding. In addition, teachers need to be aware of and understand how to design for feedback on performance and for enhancing students' knowledge acquisition and learning processes while not merely using points or badges to initiate competition to motivate them to continuing "playing" (cf. [11] [69] [68]). Having a feeling for and finding the right pedagogical balance is not only a

complex process but also a very important skill for a teacher to possess if the result is to be a well-designed gamification activity. Otherwise, the gamification designs risk being perceived as just fun and motivating but not as addressing meaningful learning [40] or providing powerful feedback on performance [68]. Although research shows that using gamification in teaching could be effective overall, if the activities are not well designed, students may prefer traditional teaching methods over gamification teaching designs [62]. Furthermore, Koehler et al. [30] argued that ignoring the complexity inherited in each knowledge area could lead to oversimplified solutions or failure. On the other hand, even if research shows that the use of points or badges in a gamification activity does not enhance student learning in the optimum manner because they lack information and does not provide informational feedback on student performance or learning [69] [68], these types of awards could motivate and engage students to some extent. This could be interpreted—similar to how the gamification activities in this study are designed as collaborative student-group treasure hunts—as meaning that these types of simple awards could help students maintain their motivation to continue solving tasks and not stop trying, even if they fail on once or twice.

The teachers participating in this study described the pedagogical balance as hard to design for in gamification activities. Some of them declared that they are not competent enough concerning the core object of the perceived value of gaming (i.e., driving forces in combination with design processes) or with the use of contemporary and emergent technologies beyond the ordinary use of computers or laptops in teaching (i.e., more or less only writing texts or searching for information on the internet).

5.1 Limitations and Future Research

Research regarding whether gamification in learning situations affects student knowledge acquisition and learning processes and how this can be managed to increase students' motivation and engagement and, in turn, improve their academic performance, is still an area that has been quite unexplored empirically in education. Furthermore, the studies that are available on using gamification in teaching show that its effects are greatly dependent on the context in which the activities are implemented and on the users [60] [61] [5] [62]. One methodological concern linked to this study is the selection of participants and its quite local character based on the use of university students as cocreators of the gamification activities. It could be assumed that obtaining more extensive data and richer nuances would have been possible if the study had included more cases and interviews with more teachers. It is hard to know whether the conclusions would be different; however, the lack of access to teachers who use gamification in teaching and my time limitations made further data collection impossible. The four sub-studies were conducted with the purpose of exploring and expanding the understanding of teachers' perception of the opportunities and challenges they face concerning the application of gamification in classroom teaching and not on teaching them on how to design for gamification activities in school.

Another methodological issue concerns the thematic analysis approach used in the analysis phase. Most certainly the study could have obtained different results if a more theory-driven analytical approach had been applied. However, the concepts of activity theory [74] in combination with thematic analysis [79] were chosen as being useful for the analysis according to the study's aim and research questions and the chosen design-based research methodology.

The first recommendation for future research is not only to expand the number of participants in order to gather more extensive information but also to conduct more design-based research studies wherein teachers have the opportunity to use derived frameworks developed by, for example, university students—such as those in the four substudies in this paper—as a support when designing gamification activities in collaboration with their teacher colleagues. These types of studies could broaden the understanding of and may add other perspectives concerning teacher readiness for using gamification in teaching. Another recommendation for future research is to include students' perspectives to a greater extent and use interviews or surveys, for example, to collect data on the opportunities and challenges they perceive in such teaching designs.

6 Conclusions

Teacher readiness for designing gamification activities to motivate and engage students in schoolwork to a greater extent and to enhance their knowledge acquisition and learning processes is a complex process and requires both skills and organisational changes at several levels. It requires skills in designing an activity to include both fun and knowledge elements and in combining this with the different knowledge areas (e.g., TPACK, knowledge of the importance of feedback). In addition, there are requirements on other levels, for example, extensive competence development and organisational changes due to collaborative design processes. If teachers are to be ready to plan, design, and conduct digitalised gamification activities using contemporary and emerging technologies in K–12 education, their personal competence in the field is not the only concern. It also requires a change in school organisational strategies. Principals need to not only identify strategies for teacher competence development in this knowledge area, for example, according to the TPACK model [30], but also create preconditions for teachers to be able to collaborate in teams and organise competence development in design processes. This is vital if gamification as a teaching strategy is to make real inroads into K–12 education (cf. [42] [46] [30]). As Jahnke et al. [44] argued, it is time to reconsider established concepts of teaching methods and move away from focusing on course-based learning in favour of designing for learning expeditions if students are to perceive teaching activities and learning processes in school as meaningful to a greater extent [40].

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