

Article

Game On, Reflection On: Reflection Diaries as a Tool for Promoting Reflection Skills in Geography Lessons

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Abstract: In this study, a diary was developed and used by students to reflect on digital games in geography lessons. The students' reflection results, through the use of the diary, were compared with reflections without instructional guidance. These results show a significant improvement in reflection through the use of the reflection diary compared to a previous study. Through the combination of lessons, play phases, and the reflection diary, a learning arrangement that enables in-depth reflections at different levels of reflection was created. The medium plays a decisive role by taking the pupils out of their role as players and enabling a critical distance to the game. With the help of the reflection diary, students should be able to better reflect on the game. The reflection diary is integrated into the lessons. It also shows that subject-specific lessons are indispensable for reflecting on the gaming experience in order to counteract subject-specific misconceptions.

Keywords: digital game-based learning; urban planning game; reflection competence; reflection diary; geography lessons



Citation: Baßeng, G.; Budke, A. Game On, Reflection On: Reflection Diaries as a Tool for Promoting Reflection Skills in Geography Lessons. *Educ. Sci.* **2024**, *14*, 316. <https://doi.org/10.3390/educsci14030316>

Academic Editors: Sandro Serpa and Maria José Sá

Received: 30 January 2024

Revised: 11 March 2024

Accepted: 12 March 2024

Published: 16 March 2024



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1. Introduction

Digital games are becoming increasingly important in the classroom [1] as they can be used to teach content, media competence, and specific knowledge in subject lessons, in an interactive and engaging way. They combine fun and education, which makes learning more interesting and motivating for students [1]. In today's world, children and young people are growing up with new media and social networks. Therefore, it is important to build on students' everyday experiences [2]. According to Prenksy [3], students have a positive attitude towards video and computer games. Therefore, educational media that are of particular interest to students should be used.

Studies have shown that the number of video game players worldwide will increase to three billion by 2023 [4–6]. Other studies show that 90% of young people in Germany between the ages of 10 and 18 play digital games for up to two hours a day [4–6]. In summary, it can be said that millions of people play digital games as a leisure activity but may not be aware of the learning processes that are triggered by the games [7].

Digital games can be used as a learning medium in the classroom for different subjects and age groups [8]. According to a systematic review and meta-analysis by Clark and Tanner-Smith [9], digital games offer the possibility of using simulations and virtual experiments to facilitate the understanding of complex phenomena in the natural sciences, for example. Similarly, in his collection of essays, Gee [10] emphasizes the positive impact of digital games on students' learning and literacy. Reinders [8], based on various studies, emphasizes that in the field of language learning, there are positive effects of games in terms of motivation, willingness to communicate, language socialization, and other language learning processes.

In addition, digital games in the classroom can also help to develop students' social and cognitive skills. Squire [11] argues that many games require teamwork, critical thinking,

problem solving, and decision-making. Playing games together and interacting with other students also promotes social skills such as communication, cooperation, and conflict resolution [12]. Learning through games offers a variety of benefits for all age groups. Games stimulate the interest of learners and increase their willingness to actively engage with the subject matter. The playful component involves learners in the game process [7].

By actively participating in the game, they can apply their knowledge and skills, solve problems, make decisions, and experience consequences [13]. This promotes deeper understanding and better retention of learning. Furthermore, games provide a safe space where learners can make mistakes and learn from them without negative consequences in real life [14]. By having the opportunity to try different approaches and experience consequences, learners can improve their decision-making and develop new strategies [2]. However, it is important to distinguish between serious games and commercial games. There is no single definition of serious games, but they can be distinguished from commercial games. Abt [15] makes the distinction between commercial games clearer by explicitly emphasizing that serious games have an educational goal, although commercial games have some advantages. Commercial games can increase motivation and engagement in the classroom [16]. In addition, many games require critical thinking and problem solving skills to overcome challenges in the game. These skills can be transferred to other areas of learning [17]. The games also provide an immersive experience that can enhance the understanding of content. Students learn through hands-on experience [16]. The culture of error and perseverance is also repeatedly emphasized. Games encourage students to learn from mistakes and develop perseverance to overcome difficult challenges. These skills and abilities are also relevant in a school context [2]. In addition, commercial games address complex systemic geographic issues such as climate change, migration, urban development, and resource use [18]. The complexity arises from the many controllable variables, the different actors, the required actions, and the difficulty of predicting the subsequent effects [19]. Due to the high complexity of commercial games, students engage with the game system and are motivated to learn its mechanics [20].

It should be noted that commercial games have great potential as educational media and are often superior to serious games in terms of the complexity, design, and treatment of current social issues, some of which allow very limited actions and whose design is often less appealing [21]. This paper therefore refers to commercial games used as learning media in geography classrooms.

Reflecting on the game experience and content after playing the game in class is very important to ensure that students do not consolidate false or oversimplified contexts and that the potential described above can be realized [22]. In addition, reflection on the medium can also contribute to the promotion of media literacy. Media literacy refers to the ability to use media, to understand and critically evaluate different aspects of media and media content, and to communicate in different contexts [23]. Reflecting on actions is also essential in gaming. Action skills can be derived and adapted to the real world. Game decisions and actions can be used to gain knowledge about oneself and to highlight one's own values (personality development) [22].

A study by Baßeng and Budke [22] shows that students who played a digital city-building game (PocketCity) in class, and were then asked to reflect on it without being instructed to do so in class, primarily reflected on the game logic and game mechanisms. By trying out different actions, they were able to see immediate effects and thus make direct connections. However, self-reflection was limited. Students also have great difficulty comparing the reality of the game with the reality outside the game. There are also hardly any approaches to reflect on the medium. Lux and Budke [24] came to similar conclusions in their study. They investigated the extent to which young players can reflect on social issues in digital games in an informal context.

In the present study (follow-on study) we build on the results presented on students' reflection of digital games without instructional guidance [22] by repeating the study and this time using a reflection diary as a didactic tool to support game reflection accompanying

games in geography classes. The reflection diary is based on the structure of a learning diary. This means that students are asked reflection questions that they have to answer in writing after the game phases. The play phase is when the students play the game on their own.

In an intervention study in Germany with 29 tenth grade students (age 15–16) who played the digital city-building game PocketCity in geography class, we investigated the following research question:

To what extent can students' reflection skills on digital games be improved by using a reflection diary, parallel to playing the game, compared to reflection without instructional guidance [22]?

In the following chapters, the theoretical background, methodology, and results of the study are presented and discussed.

2. Theoretical Basics

2.1. Learning Potential of Digital Games and Game-Based Learning

Digital games offer great potential for learning in the classroom. They can motivate students in a variety of ways, expand their knowledge, and improve their cognitive skills [8]. By properly embedding digital games or game elements in the classroom (game-based learning), subject-specific learning can be deepened.

It is difficult to find a universal definition of game-based learning [25]. Most definitions or concepts emphasize that games are used to acquire knowledge, or for educational purposes [26]. Game-based learning offers great potential for making classroom learning effective and motivating. By using playful elements, students are actively involved in the learning process and can expand their knowledge and skills in a fun and entertaining way [27]. Players also have to act according to certain rules and solve tasks in order to be successful in the game. Digital games create new spaces for action and experience in which students can learn individually and at their own pace [28]. Research has shown that game-based learning increases student engagement and motivation. The playful nature of the learning activities can motivate learners to engage more deeply with the subject matter. For example, a study by Clark et al. [9] found that students who used game-based learning in math classrooms had higher levels of intrinsic motivation and a better understanding of math concepts than students who were not exposed to game-based learning.

In addition, game-based learning promotes the development of students' problem-solving and critical thinking skills [2]. Playful elements, such as challenges, puzzles, and decisions, in games require learners to analyze complex problems and develop solution strategies; for an overview, see [29].

Another advantage of game-based learning is the promotion of cooperation and social learning. Many games provide opportunities for students to collaborate and work together [12]. This not only strengthens their teamwork skills but also promotes knowledge sharing, collaboration, communication, and the development of social skills [30]. Incorporating playful elements such as scoring systems, levels, and rewards makes learning activities interesting and appealing [31]. A study by Hamari et al. [32] found that the playful design of educational applications can increase students' intrinsic motivation. Digital games also allow learners to be active and apply their knowledge, with creative use contributing to media literacy and digital maturity [33]. They often offer complex scenarios and problem-solving tasks that require students to apply their knowledge in practice. This promotes critical thinking (consider different perspectives), decision-making, and problem-solving skills [8,34]. A study by Clark et al. [9] found that students who used digital games in class had higher levels of active participation and interaction than students who did not play digital games. Digital games can be tailored to individual learning needs. In addition, they can offer different levels of difficulty, customization options, and feedback mechanisms to meet the diverse needs of learners. A study by Hwang et al. [35] showed that adaptive digital games can improve student learning outcomes. Digital games can be used to convey complex content in a clear and engaging way. Simulations and interactive

experiences can make abstract concepts more tangible, allowing students to acquire skills and reflect on and question their own choices; all of this can be tested in a safe space [14]. A meta-analysis by Wouters et al. [36], which examined the learning effectiveness of serious games compared to conventional teaching methods, concluded that digital games have a positive effect on knowledge acquisition and the ability to apply knowledge. The players achieved a particularly high learning effect when the game was complemented by other teaching methods [36]. A meta-analysis by Vogel et al. [37] also concluded that students who learned with games and simulations achieved significantly better results and more positive attitudes toward learning than students who were taught traditionally.

Digital games are used in the classroom to stimulate motivational processes, arouse interest in certain topics, use interactive learning methods, and present phenomena in a realistic way [12,38–42]. Petko [12] also mentions the high motivational potential of digital games in the classroom, especially for students who otherwise find it difficult to get excited about learning content or who have low attention/concentration spans. Commercial digital games often model geographic issues such as urban development, climate change, migration, and sustainable resource use [43]. Students themselves also recognize geographic themes in commercial games, such as natural disasters, interacting with nature, or dealing with wars and crises [44]. In one study, Jolly and Budke [45] investigated whether the commercial digital simulation game “Cities: Skylines” allows players to simulate sustainable urban development. The scientific criteria and indicators of sustainable urban development in the game are cited as key findings. The game “Cities: Skylines” offers the opportunity to gain deep insights into sustainable urban planning [45]. Students can learn and experience the connection between urban geography and sustainable cities in practice, which means that the game has great potential for geography education [45]. Morwaski and Wolff-Seidel [44] summarize that video games are a valuable tool for geography education, but it is important to carefully analyze the limitations and opportunities, as well as critically evaluate the content, before using the game in the classroom. Games can be used for more than just creating your own learning products or completing assignments. It is also possible to consider games as objects of study and to analyze and discuss their content and forms of presentation. Digital games can be used as an object of reflection in the classroom [46]. However, most of the existing studies investigate learning gains and motivation through digital games. Targeted studies on the reflection of digital games in the classroom are not yet available.

In addition, few didactic approaches are known to support students’ ability to reflect on the content of digital games. In this context, we developed and tested the reflection diary.

2.2. From Learning Diary to Reflection Diary

First of all, the term reflection needs to be looked at more closely. The term reflection can be divided into reflection on content and the learning experience, according to Dewey [47], as well as reflection on one’s own actions and the development of alternative courses of action, according to Schön [48,49]. Furthermore, a distinction is made between the concepts of reflection and reflexivity [50]. The difference is that reflection takes place at the level of the object, while reflexivity is based on the level of one’s own perspective and self-reflection. This means that one considers one’s own thoughts and actions in relation to an object by changing one’s perspective [50]. The model in Figure 1 is used to reflect on digital games in the classroom [24] and has four different levels: reflection of the system in the context of the game, reflection of the system in the context of the world outside the game, self-reflection, and reflection of the medium (digital game). Reflection of the system in the context of the game, as well as at the reflection in the context of the world outside the game, is important because reflection helps to distinguish the game logic from reality outside the game and to recognize the successes and limitations of the game in modeling real-life situations ([24]; level 2). The reflection of the medium is also highly relevant. This concept of reflection is often found in connection with media literacy [24], which includes the critical handling and reflection of media [51]. Students should recognize

the potentials and limitations of the medium of digital games in order to learn how to use this medium critically and competently ([24]; level 4). These reflections can relate either to the medium of digital games in general or to digital games as an educational medium. Players' self-reflection is also important in order to understand their role in the game and in reality, as well as their actions, attitudes, and values ([24]; level 3).



Figure 1. Model of the levels of reflection on digital games [24].

Since the previous study [22] had shown that students reflect on digital games without guidance in the classroom, primarily at the level of the system at the game level (level 1, Figure 1), an intervention was created to guide reflection at all levels of the model. Based on this model, reflection diary questions were created for students to answer after the game phases. The design principles of learning diaries were used in the creation process.

Learning diaries are understood as “continuous, written and reflective engagement” [52] with learning content or the learning process [53,54]. The goal is to encourage students to engage with their own learning process and to deepen their understanding of learning content, as well as to implement strategic learning [55].

Learning diaries enable students to reflect on their learning processes, deepen their understanding, and consolidate their knowledge. This approach can promote self-directed learning, metacognitive skills [56,57], and the development of writing skills.

A study by Guce [58] investigated the use of reflection journals in mathematics classrooms. The results of the study showed that reflection journals had several positive effects. First, they enabled students to construct meaning and express their personal views and ideas. Second, the journals fostered a close relationship between teachers and students. In addition, the use of prompts in the journals improved students' understanding by connecting mathematics to real-world facts, and the journals helped students to make connections between ideas by using their prior knowledge and experiences. Finally, the journals helped students to develop self-confidence.

Another study [59] examined the use of learning journals in higher education and found that reflection through journal writing helped students understand their learning processes and recognize their thinking patterns. This led to improved metacognitive skills and better self-regulation of learning.

In Hatton and Smith's [60] study, using learning diaries in a medical education program, it was found that by reflecting in their learning diaries, students developed a deeper understanding of the topics covered and improved their critical thinking skills.

Reflection in journals can also help students to better organize their knowledge and make connections between different learning content. A study by Boud [61] investigated the use of learning diaries in university education and found that reflection in diaries helped students to structure their knowledge and improve their learning outcomes. The use of learning diaries in the classroom is varied [62,63]. Learning diaries are also often used in adult education, e.g., for student teachers during their internship. The focus is often on the critical reflection of one's own practice [64]. Hartung-Beck and Schlag [62] emphasize that successful and self-regulated reflection requires targeted instruction and support from faculty staff. Hartung-Beck and Schlag [62] summarize what is needed to create an effective learning diary.

They cite guiding questions or prompts (cues to activate knowledge) as conducive to learning [52,65].

In an empirical article by Hartung-Beck and Schlag [62], they point out that the length of the learning diary and the frequency (how often the learning diary is used) [66] also influence the quality of the learners' reflections. They also see a connection between these two factors and acceptance and motivation to write a learning diary. They note that learner acceptance can be influenced by providing information about goals and benefits.

They see the detailed feedback as another important point. The feedback was found to be particularly helpful, especially as a supplement to the prompts. Based on the evaluations, Roelle et al. [67] were able to show that feedback from instructors, in addition to guiding questions/prompts, leads to positive learning experiences, especially for learners with a low level of expertise. Strauch et al. [66] emphasize that working with the learning diary should be integrated into the entire learning process. Fixed processing times need to be respected and planned [66].

The above-mentioned design approaches for learning diaries were followed and adapted to a diary for reflection on digital games. The reflection questions were developed on the basis of a model of levels of reflection on digital games ([24]; see Figure 1). The questions were answered partly in writing and partly orally by the students (see Figure 2).

Structure of reflection diary - selected questions

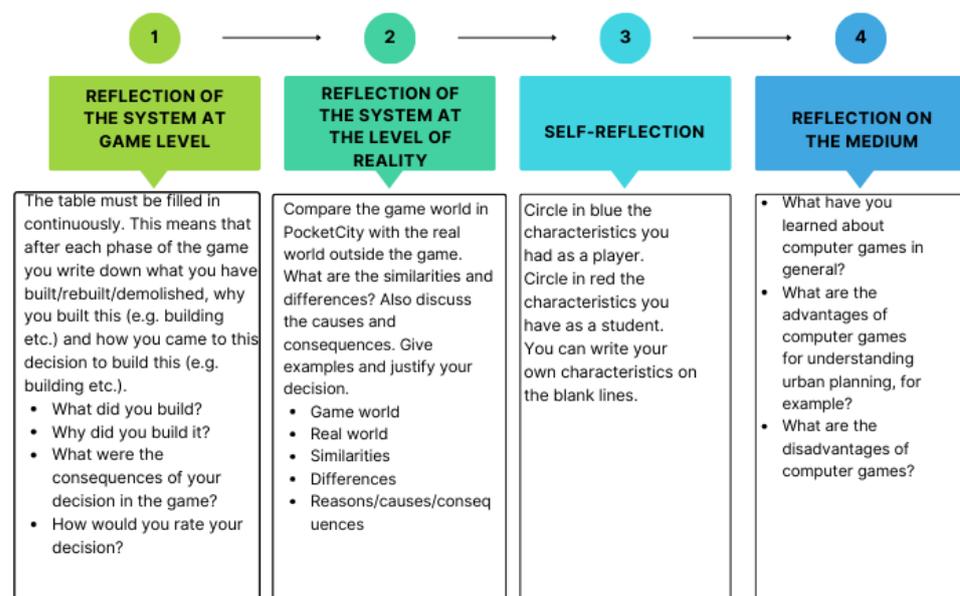


Figure 2. Structure of the reflection diary—selected questions (own illustration).

The focus of the reflection diary is to reflect on the game experiences on different levels (see Figure 1), and, for each level, questions were formulated, some of which are shown as examples in Figure 2.

3. Materials and Methods

This chapter presents and justifies the methods used in this research.

3.1. Sample and Selection of the Game

A total of 29 students, 16 female and 13 male, participated in this study. All 29 students attend the tenth grade of a public secondary school in North Rhine-Westphalia and form a natural class (a class that was not put together specifically for the study). There is one transfer student in this class who is learning German as a second language. The students are between 15 and 16 years old. In order to find out about their previous experience with digital games, we used a pre-test in which we asked about their previous knowledge and digital equipment. Based on the pre-test, it can be seen that the students in our study have similar characteristics to the young people in the JIM study (JIM = Young, Information, Media) (2021) [68] and the study by Baßeng and Budke (2023) [22] in terms of socio-demographics, device equipment, and media activities in their free time.

In addition, it can be noted that almost all students, with one exception, had already gained experience with digital games. There were no gender differences. This means that almost all students had the same prior knowledge of digital games.

The aim of the sample selection was to ensure that the topic of the research project (urban development) fit both the lesson plan and the curriculum of the ninth and tenth grade. In grades 7–10, at secondary schools in North Rhine-Westphalia, the urban theme is very relevant for geography classes (see the core curriculum for secondary schools in North Rhine-Westphalia). Topics such as mixing and segregating functions, basic functions of existence within the city, and the structure of a city are mentioned. In geography classes, students should acquire various skills, such as the analysis of human–environment relationships (SK 6), the recognition of possible conflicts or future situations through simulation games (here: digital games, MK 8), and the ability to plan, implement, and evaluate a subject-related project, e.g., the creation of their own city (HK 6) [69].

The students played the commercial city-building game “PocketCity” (developed by Codebrew Games) for 90 min (two lessons) per week over a period of seven weeks and completed the reflection diary.

The decision to use PocketCity was based on the fact that it is easy to understand and less complex than other city-building games such as Civilization VI or Topico [19]. It was considered appropriate for this age group and this type of school. Simplifying the content of the game was important as it was intended to be used in a school context. The city-building game is available as an app and can be easily installed on tablets and smartphones.

“PocketCity” is particularly suitable for introducing students to the genre of economic and urban planning simulations. It takes into account the basic mechanisms and functions of a city, such as living, working, recreation, etc. Although the game has a simple structure and is easy to understand, it offers a sophisticated depth of play that is particularly suitable for geography classes.

In PocketCity, players must build and expand a city while maintaining a good balance between residential areas, commercial and industrial zones, and recreational facilities. The infrastructure, such as road connections and water and electricity supplies, must also be taken into account. Players take on the role of the mayor and receive information about missing buildings or requests from citizens via comment functions. If the players follow these instructions and the city grows in size and population, they advance to the next level, where “special” buildings such as a zoo, castle, or Ferris wheel are unlocked [70].

3.2. Research Design

In order to obtain high-quality results, a combination of quantitative (pre-test) and qualitative (reflection diary) survey methods was used.

In the pre-test, the focus was on collecting information on gaming experience, home equipment, and students' prior knowledge of the functions of a city/urban planning. Media-related questions are based on the JIM study (2021) [68]. The reason for basing the questions on the JIM study is to use a validated survey tool, to form validated categories, and to be able to classify the sample in terms of representativeness [22]. Furthermore, the learning groups from the first study can be compared with each other as the procedure is the same [22]. As described above, the reflection diary was created based on the principles of learning diaries. Questions from the pre-test were also included in order to establish comparability with regard to the knowledge acquired in relation to the functions of the city/urban planning. In addition, tasks were set that had to be completed repeatedly throughout the entire game phase (see Figure 2). This was carried out to assess the students' ability to reflect on the game and their knowledge of urban functions and urban planning.

The teacher was able to view the reflection diaries, but there was no sharing among the students. The oral responses, which were also included in the reflection diary, were recorded using the voice memo function of the iPad. The survey methods were the same as in the first study in order to best compare the results. The survey method using the voice memo function also proved to be very advantageous [22]. On the one hand, the students can explain their answers in detail, and, on the other hand, the interviewer cannot influence the answers, which means there is an advantage in that the answers have a low social desirability. The questionnaire (pre-test) and the reflection diary were completed voluntarily by the students. Therefore, the response rate was 100%. Parents and pupils were given comprehensive information about the study. A declaration of consent was also obtained from the parents. The first author was also the teacher who conducted the study and therefore had knowledge of the students' strengths and weaknesses from the classroom.

Figure 3 illustrates the chronological and methodological approach.

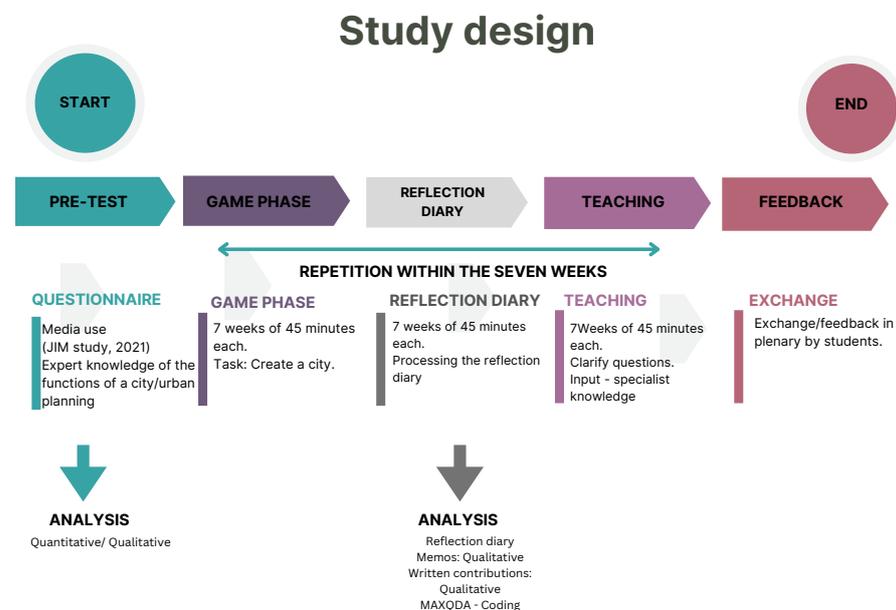


Figure 3. Study design (own illustration).

First, the students completed the questionnaire (pre-test) on media use/equipment and subject knowledge. This was followed by a 45 min game phase. The students were asked to build a city using the urban planning game PocketCity. This was followed by a 45 min teaching phase. The lessons were designed to clarify the students' questions/uncertainties

and thus generate knowledge growth. The students' questions allowed for a more in-depth discussion of certain topics, such as the separation and mixing of functions. The teaching phase was also used to fill in the reflection journal in detail. The alternating play and teaching phases were played/taught over seven weeks, each lasting 45 min. At the end, the students reflected on the study project. There was a final exchange in plenary.

3.3. Evaluation

The data from the pretest were statistically analyzed descriptively. The pretest was analyzed using the Excel spreadsheet program. The voice memos from the reflection diary were transcribed. The transcripts and the written contributions from the reflection diary were then analyzed using MAXQDA (software version 2022 for qualitative data analysis) according to Mayring's (2010) [71] qualitative content analysis. First, deductive categories related to the model were formed (see Figure 1). The decision to conduct the analysis deductively is due to the fact that the approach is theory-based and because the analysis from the first study was also deductive. Further inductive subcategories were created based on the empirical data so that no important information was lost. The texts were then read again for relevant information and the individual and important information was then assigned to the categories (coding) (see Figure 4). Finally, all the collected information was summarized.

Categories	Sub-categories	Sample questions/tasks from the reflection diary	Exemplary answers
1. Reflection of the game at game level (Internal)	Game mechanics Success factors Player role etc.	Please describe how the game works.	"So the game works in such a way that you have three different operating modes, i.e. commercial area, industrial area and residential area. Exactly. And as mayor, you also have total power and you can basically decide everything and build everything (MK175)."
2. Reflection of the game on the level of reality outside the game (external)	Specialist knowledge Comparison between the game world and reality etc.	To what extent did you learn anything about geography while playing?	"For example, I got to know the mixing and separation of functions better and how this works and looks. And the basic functions of existence in general were also explained in more detail in the game (AA127)."
3. Self-reflection	Student characteristics Characteristics Player	Name your characteristics as a player/student.	"I'm more motivated as a player than in class, which could be because you rattle everything off at school and only see your progress at the end; in the game you can see your progress immediately. Maybe I should motivate myself more and become more active in the real world again (LL55)."
4. Reflection on the medium	Play in general Play as a learning medium	What are the advantages of computer games for understanding urban planning, for example?	"Yes, the advantages are that practice is combined with theory and so it is better, more memorable and also easier to understand if you can try something out yourself or try and do it yourself (HA34)."

Figure 4. Presentation of the categories/questions of the reflection diary and sample answers from the students (own illustration).

3.4. Reflection on Methods

A possible weakness of the study is that the written answers to the questions in the reflection diary were given in individual work, and it was not possible to ask the students any questions about ambiguities. Nevertheless, it can be stated that the choice of methods led to valuable information that served to answer the research question. The decision to record some questions in the reflection diary as audio recordings is due to the fact that most students find it easier to describe processes verbally. In addition, a variety of methods (written contributions and oral contributions) are of great importance [72,73] in order to maintain motivation to complete the reflection diary conscientiously. The small sample size ($N = 29$) should also be mentioned, as it is not possible to draw any general conclusions from this. Accordingly, this is an exploratory study. It should also be noted that the study only took place at one type of school in Germany—Realschule. It cannot be ruled out that different results were obtained at other types of school. There is also a weakness in terms of validity, as the variables are not directly observable or measurable [74], but an

attempt was made to achieve the highest possible validity by formulating the questions in the reflection diary using the model (see Figure 1). A certain blindness to already defined analysis categories can also arise, so that not all results fit into the defined categories. However, the deductive approach was deliberately chosen because, as already described above, the evaluation was consistent with the first study [22], and the main categories were created on the basis of the model (see Figure 1). These categories proved to be very useful for analyzing the results, and it was possible to draw a precise picture of the different levels of reflection.

4. Results

The results of the study are presented below, structured according to the four levels of the model for reflecting on digital games (see Figure 1).

4.1. Reflection

Below is a reflection of the system in the context of the game (model level 1).

Questions on reflecting on the game system were often answered in great detail by the test subjects. It can be seen that the test subjects were largely able to understand the content and the contexts and had thus internalized the game logic.

The students were usually able to name the factors for success in the game and the role they played.

“You take on the role of the mayor in the game”. (AA127)

In response to the question regarding the central game mechanics “Please describe how the game works!”, almost all students mentioned the construction of the various zones—industrial, commercial and residential areas—as well as the attention paid to the satisfaction of the population. This was followed by “money” and “completing tasks (quests)” as further success factors.

The students correctly highlighted the success factors and thus also recognized connections. The monetary resource was important in the game in order to acquire more territory and expand the city. In addition, expanding the city and successfully completing the quests takes you to the next level, which, in turn, unlocks more buildings. The students also mentioned the satisfaction of the population, which is dependent on other factors: for example, the higher the satisfaction, the more population in the city. The students had to respond to the wishes of the population and, for example, reduce taxes in order to increase the population’s satisfaction.

“You have to earn money, and to earn money you need residents in the city. And these residents have to work, but at the same time be satisfied with their lives so that they leave money for you. And you get money, for example, by building this leisure facility or raising taxes, which in turn reduces the satisfaction of the residents”. (LA109)

“You should always build the city bigger and construct more important buildings that meet the needs of the citizens. You should also always make sure that there are enough citizens in the city, i.e., satisfy leisure activities and needs. Updates for zones and improvements for zones should be used. You should always make sure that demand and supply are roughly equal”. (FI274)

In the game, the students find themselves in situations in which decisions have to be made between several conflicting goals. Some learners realize that they cannot consider all goals or achieve all goals at the same time (see quote from LA109).

The second example shows that the learner has developed a strategy to deal with the different demands. It is clear that the learner considers the balance between the different parameters to be very important and so explains his next steps.

In general, the two examples show that the students demonstrate a systemic way of thinking as they recognize causal relationships in the game mechanics, e.g., between the number of inhabitants and population satisfaction/increase/decrease in taxes, but also

between “earning money” and “buying territory” as well as fulfilling quests, and they derive action decisions from this.

The examples also show that students see the interaction between the population and income/taxes. If one element changes, it affects the other. Almost all of the students’ answers are very detailed. Based on the quality and depth of the answers, it can be said that the students largely understood the logic of the game. They also named their strategies (What needs to be done now to progress in the future?) in the game to make it successful.

“You start building residential areas. You get taxes. With the taxes you can build more roads to build business parks and industrial estates so that people have places to work. And then they start working in the jobs and then you get more money. You can then use the money to buy more land and expand your city. You always need enough power plants and resources. If there is a certain capacity that the power stations and waterworks can accommodate, that means, for example, a small power station for 50 houses and then you build them and once you have built them, you can connect everything. So that runs via the roads, to the houses and to the buildings, to the leisure activities or power plants/steel plants”. (YZ9)

The example shows that the student is able to recognize the dependencies of different (success) factors. He realizes that power plants can only supply a certain number of houses and that there must be several power plants to supply an entire city with electricity.

Based on his decisions and feedback, the student realizes that not only one power plant is sufficient for his city but that several are needed. He has to solve a complex problem by making repeated decisions. The game reacts to the player’s decisions, for example, with feedback functions. The students then have to react to the game’s reaction. Students understand that they cannot take all factors into account satisfactorily and develop a strategic approach.

4.2. Reflection of the System in the Context of the World Outside the Game (Model Level 2)

At this level, a comparison between the game (PocketCity) and the real world outside the game is made in order to identify similar contexts and to recognize the limitations of the game.

In the task of comparing the game world with the real world, all students gave detailed answers in their reflection diary.

They often made visual comparisons. For example, they wrote that the “red cross” symbol in the game is typical of a hospital. The symbol is used in both the game world and the real world to identify a hospital.

The students mentioned other differences between the game world and the real world that also helped them to identify the limitations of the game. For example, some students mentioned the limited infrastructure expansion. Students were only able to build the buildings specified in the game. For example, only one port could be built. In the real world, unlike the game world, you can build multiple ports. Also, you do not have to wait for a higher level to build buildings.

Some students noted that the options for action in the game were limited. The game provides the options, and the players must build a city with those options.

Many students realized that some options in the game were not comparable to the real world. For example, farms could only be built on a certain type of land.

Many students also questioned the limited number of stops (game elements) they could build and felt limited in their actions as a result.

“There are more stops in real life—in the game you can only build stations”. (NA39)

Only one student explicitly mentioned the limitations in reality (cf. LO88). Different options for action in the real world are also influenced by different regulations. An example of this is the construction of buildings, which must comply with various regulations and standards. There are also other constraints in reality, such as existing laws and socio-

political groups. The student only mentions the laws that need to be taken into account but does not go into further detail.

“I’ve learned about computer games in general that everything that goes through an app doesn’t always correspond exactly to reality. By reality I mean, for example, that you have to obey laws in the city, but you don’t have to do that in the game online.”. (see LO88)

There is also an option to turn off the forces of nature in the game, such as tornadoes or volcanic eruptions. All subjects were aware that this option was only available within the game and not outside the game. All students found this option unrealistic.

Many students also critically questioned the high level of power of the player in the game, who as the mayor decides on urban planning, and classified it as unrealistic in the context of urban planning.

“In the game, you are the mayor. You have to build and decide everything. You have the ultimate power. This role is very unrealistic, because in reality the mayor only has the right to co-decide at best. In reality, the mayor does not make as many decisions as in the game. In the game, you have ultimate control, you can decide everything and even change the landscape. This is very unrealistic”. (FI274)

This example makes it clear that the respondent considers the high position of power of the player who makes the decisions as mayor to be illogical. The choices of words “ultimate control” and “this role is very unrealistic (...)” make it clear that the learner thinks that this position of power is only possible in the game. The learner compares the mayor’s position of power in the game to the real world and can therefore clearly identify the misrepresentation of the position of power in relation to the real world. By comparing the game with the real world, the learner can more precisely name the flawed structures in the game; as a justification, he names the political structures, i.e., the structure of the political–democratic system.

4.3. Self-Reflection (Model Level 3)

On the level of self-reflection, we were able to show that all students were able to name their characteristics as a player and as a student in great detail. They were therefore able to differentiate between these two roles.

All students described themselves as motivated and interested when they were in the player role: *“Ambitious, motivated, interested (cf. e.g., JN106)”*.

The following example shows a student reflecting on her behavior in the game. She analyzes her playing style and derives personal characteristics.

“As a player, I’m more motivated and ready to develop everything in the game, it’s very varied and fun. You have to be organized to coordinate everything in the game. The game shows me that I can keep calm when I need to”. (TO467)

Another student even derived a future career aspiration from the gaming experience. *“All in all, games are more fun and more interesting. They are captivating and educational at the same time. I could imagine a career in IT because I love digital things (MK175).”* Another student also draws conclusions from the gaming experience and links them to his behavior in everyday life: *“It (the game) showed me that I should pay more attention to things where I can help shape things (LN340).*

Another student compares her self-observations during the game and at school, recognizes some similar characteristics in herself, and analyses her different feelings when learning with digital games and in “normal” lessons. She draws conclusions as to which learning settings would be suitable for her.

“There aren’t really any differences between my characteristics in the game world and my characteristics in the real world. In both, I’m motivated, I care about others and I’m interested. However, I notice that I have a lot more fun when I’m playing than in class. I always look forward to lessons because the game allows you to combine creativity and strategy with learning. You learn while you play the game and that’s something different.

For my everyday life as a student, I notice that I have more fun learning in a playful and virtual way". (AN311)

Individual students describe how the quick and visible success in the game contributes to a high level of motivation to learn as well as the powerful player role they take on in the game. *"I am motivated because you can see clear learning successes and my participation in lessons, you have a clear connection to life and you feel in a position of power" (BA11).*

In general, learners have found access to reflect on their learning experiences and preferences through their gaming experiences.

4.4. Reflection of the Medium (Model Level 4)

In response to the question "What benefits did playing digital games in class have for you as a student?", all the students said that the game made it easier to understand the topics of urban planning and the functions of a city. They also mentioned the fun of learning and the change from other teaching methods. They also praised the opportunities to try things out and the visual representation of the topics (urban planning and basic functions of existence) (cf. YZ9).

"For me as a student, it's cool to play games in class, because it's a better way to teach things and you can process things better by playing. You remember it better because you're also playing it yourself and trying it out and you can see what's possible and what's not possible. You can just let your thoughts run free and try things out so that you can ask yourself questions and answer them yourself". (YZ9)

"Yes, I found it very helpful because sometimes you were at a point where you didn't understand why people were moving away from the city and why you weren't getting any more money. And then in class, when you discussed, for example, the basic functions of existence and so on and then you realized, oh, I'm not fulfilling one of them, then you changed it and then suddenly people came back and it helped you a lot. Or also how to really separate and mix functions properly once you had the money to implement it". (NA39)

The second quote shows that the student praises the combination of learning and play in the lesson. He was able to gain expertise through the lesson and tried to use this knowledge in the game. The student recognized that individual factors depend on others. Furthermore, the student mentions the possibility to try things out as an important advantage of digital games. For the learner, the self-control and self-efficacy experienced while playing the game is crucial for a positive learning experience.

Compared to school lessons, the game offers a space without grading performance. Students can perform actions in the game that they can correct again. Subjects described this option as particularly helpful for learning.

"The advantages of computer games, for example to better understand urban planning, are that they improve me when I make mistakes and give me tips on how I can do better next time so that I don't repeat these mistakes". (LN340)

"In the game world, you learn while playing and can memorize things much better. You also have more fun and no stress when learning. In the real world you have more pressure, maybe you have to choose different strategies". (FI88)

Several learners mentioned the high pressure to perform in class as opposed to playing the game. The digital game PocketCity is perceived as a counterbalance to "normal" lessons. In relation to this, one student (FI88) mentions that a different strategy should be chosen; it can be assumed that he is referring to the learning methods in lessons and that the regular uses of digital games in lessons can create a balance between grading and sanction-free spaces.

All students were able to name general limitations of the medium of digital games outside of the classroom context. All students stated that they felt their actions were impaired by the different levels. The students were only able to "unlock" certain leisure

attractions (e.g., amusement park and Ferris wheel) or buildings (e.g., schools and town hall) at higher levels. This meant that the students were not in a position to consider all the basic functions of existence within a city right from the start (cf. BA11).

“I felt restricted when I wanted to build things like a harbor but couldn’t because of my low level”. (BA11)

“If you didn’t have enough money, you couldn’t fulfill any tasks. For example, building a school so that the children could go to school and continue their education. You couldn’t do that, for example, because you didn’t have enough money. Or if you needed more security, you couldn’t directly build more fire departments and police stations because you didn’t have enough money and weren’t at the level where you could get a fire department, for example”. (LL55)

The examples show that the students were able to perceive the different obstacles in the game they played but without drawing conclusions for the medium of digital games in general.

In addition, the students were limited in their choices because some actions were dependent on higher levels. Students were not able to choose between separating and mixing functions at the beginning of the game.

In general, the players felt restricted at all times due to a small amount of money, small areas, and the dependence on the level, as they were unable to directly implement content from the lessons.

Topics such as separation/mixing of functions and the basic functions of existence were covered in class, but these could only be considered gradually during the game, which the players found annoying. They also found it a hindrance that all locations had to be connected to each other: *“Roads must always be connected—even to the beach (JN106)”*, and buildings could not be *“rotated”*: *“Houses cannot be rotated, can only be built in one direction (ND75)”*. This made the buildings very static and not adaptable to the environment. The students thus also experienced the limits of the game played but without thinking about why these limits exist. For example, none of the learners pointed out that digital games are created by game developers and are used for entertainment. For a game to be playable at all, the content must be reduced in its complexity, and the students did not mention this point either.

It is particularly noteworthy that all students were only able to name the general advantages and disadvantages of digital games to a limited extent. This example shows that the students summarize general advantages such as being able to express creativity within a game.

“Computer games have taught me that you can simply be creative in the digital world if you can’t live it out in the real world. You can also develop yourself through computer games, you can develop new interests, you can learn things, you can be more interested in things”. (YZ9)

The advantages (as a learning medium), as already described above, relate to trial and error, the sanction-free space, and the visual representation of urban planning/basic functions of existence.

All students mention the advantage of lessons and play phases, as well as the varied methodical geography lessons.

The disadvantages, which the students reflect on very well, are also very well founded. The students can recognize the reduced representation of urban development measures.

The following examples illustrate the statement that the students have understood the limits of the medium very well. They are aware that digital games do not reflect reality and that complex structures are presented in a simplified way. In this context, one student (AA127) also mentions the disadvantage of incorrect knowledge acquisition and reflects on the importance of digital games as a learning medium.

“Disadvantages (of digital games) would be that not everything is like in real life and you could acquire the wrong knowledge”. (AA127)

In summary, the students reflected very intensively on the specific game. The learners reflected on the game in great detail with regard to its suitability as a learning and teaching medium, but reflection, in general, was only rudimentary.

5. Discussion

This study investigated the extent to which students' reflection skills in relation to digital games were improved by using a reflection diary in parallel with playing the game compared to reflection without instruction [22].

A key finding of our study is that students engaged in significantly more reflection using the reflection diary than in the first study by Baßeng and Budke [22] in which students were not instructed to reflect. This is because, as Lux and Budke [24] point out, reflection must be encouraged from the outside (e.g., by teachers) in order to address the levels of reflection that are central to deeper understanding (see Figure 1). The promotion of media literacy through the use of the reflection diary after the game phases should also be emphasized. On the one hand, media literacy refers to an individual's ability to possess and acquire knowledge about media, as well as the ability to confidently use, critically evaluate, and creatively design media. On the other hand, media literacy stands for the pedagogical-practical goal of actively promoting this potential and imparting the corresponding knowledge and skills in both formal and informal educational contexts [75].

Based on these findings, we can say that with the help of the reflection diary and the combination of lessons and play phases, we have created a learning arrangement in which learners are encouraged to reflect on different levels, to evaluate these critically, and to use media confidently.

The learning diary method is commonly used at universities or in school lessons [56]. Berthold [65] summarized in her study that learning diaries should not be used in a “content-free space” but should be linked to concrete learning and action situations [65].

Based on this knowledge, the learning unit was designed in such a way that the combination of lessons, play phases, and reflection journals was repeated (see Figure 3), which proved to be successful.

In addition, the reflection diary for this study was created based on the literature on the use of learning diaries. The questions in the reflection diary were formulated based on the model of levels of reflection on digital games [24].

Lux and Budke [24] emphasize the importance of critical distance in reflection events in order to reflect on different levels. The teacher used the reflection diary and lessons to regularly take students out of their roles as players and to create a distance from the game. This distance was crucial in order to fill in the reflection diary without being influenced.

Students are therefore encouraged by the teacher to reflect through expertise and reflection prompts.

The reflection journal was used to support and record opportunities for reflection. The teacher can use the reflection journal to address misconceptions and discuss them with the class. Peters and Vissers [76] also emphasize the added value of group reflection to bring together different perspectives.

The successful use of the reflection diary was evident in the high quality of the results. The combination of lessons and play was crucial for the effective completion of the reflection diary. The lessons allowed for questions to be asked and discussed in plenary, both in terms of comprehension and content, and the lessons also served to impart knowledge. The play phases helped to put the newly acquired knowledge into practice through play. By trying out actions and visual representations, the game also served to support subject-specific learning content. With the help of the digital game, the students were able to better visualize the complex topic of “building a city” and thus recognize the limits, dangers, and potential of the digital game. The combination of classroom and game play was rated positively by all students.

As our survey shows, the use of commercial digital games in the classroom can be extremely enriching, as it complements theoretical content with practical game play. In geography education, it is particularly important that the games have a clear reference to reality by simulating or depicting constellations that occur in the real world [12]. A study by Morawski and Wolff-Seidel [44] also shows that video games in geography education have a high potential for promoting deeper understanding, but the games must be thematically appropriately embedded in the lesson [44]. Digital games can increase motivation and engagement in the classroom; this finding should not be ignored [2,9,12,16,33,77].

With regard to our results, we can see that the levels of reflection (see Figure 1) are strongly interrelated. For example, the penetration of the internal level, i.e., the understanding of the game, is essential in order to carry out the external level, i.e., the comparison with the reality outside the game. In this comparison, the subjects already mention the first limitations of the game as a medium (see Figure 1, model level 4).

In summary, it can be said that the results are significantly better than in the first study [22]. Students were able to reflect on the game at different levels.

Compared to the first study [22], the answers are much more detailed and show deeper reflections.

It was shown that students were able to describe polytelic game situations and make decisions in them, i.e., the pursuit of multiple conflicting goals [78]. Polytelic decision situations are characterized by the fact that they do not allow for clear or unambiguous solutions, which is in line with the principles of problem-based learning as explained by Savery [79]. Situations are characterized by conflicting goals. The player must choose between them. The careful consideration of different interests and possible solutions is therefore required in these games [19]. The students were obviously able to deal with the controversial demands well and to describe them in their reflections.

Further positive results can be seen in the external level of reflection, where learners reflect more deeply and recognize the limitations of the medium. It can be said that the influence of teaching and the related expertise are indispensable for professional reflection. The expertise acquired allows students to make a comparison between the digital game world and reality.

Based on this, they are able to reflect on the external level (see Figure 1). In areas where there is little prior knowledge, there is also a lack of depth of reflection. For example, the students did not mention that in the real world one's actions are also limited, for example, by laws.

On the level of self-reflection, the test subjects now differentiate between the roles of student and player; they recognize different character traits with regard to the different roles and derive from them, for example, learning strategies or career aspirations. On the fourth level, the students also reflect on the game primarily as a learning medium, presumably because it was used in a school context. However, what the students repeatedly emphasize as particularly positive is the grading-free space. Students can try out actions and decisions and see the consequences in real time. The students' general reflection on the medium was limited. They were not able to talk about the game in an abstract way—e.g., that all digital games have to be reduced in complexity in order to be playable—nor did they mention the typical game mechanics, such as the reward system that motivates players to continue playing.

It can be assumed that the use of the reflection diary and the combination of teaching and play phases led to these successful results.

In future studies, it might be interesting to investigate the use of the reflection diary in group work, as Peters and Vissers [76] already mentioned the great importance of group reflection in bringing together different perspectives.

Author Contributions: Conceptualization, G.B. and A.B.; methodology, G.B. and A.B.; data curation, G.B.; formal analysis, G.B.; investigation, G.B.; project administration, A.B.; supervision, A.B.; writing—original draft preparation, G.B.; writing—review and editing, G.B. and A.B.; visualization, G.B.; funding acquisition, A.B. All authors have read and agreed to the published version of the manuscript.

Funding: The APC of this research was funded by the German Research Foundation (DFG), grant number 491454339.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest.

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