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Developing Goals and Objectives for Gameplay and Learning

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LEARNING, EDUCATION & GAMES

VOLUME ONE: CURRICULAR AND DESIGN CONSIDERATIONS

Edited by Karen Schrier | *Written by members of the Learning, Education and Games (LEG)*
Special Interest Group (SIG) of the International Game Developers Association (IGDA)

Learning, Education and Games
Volume One: Curricular and Design Considerations

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Learning, Education and Games
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Developing Goals and Objectives for Gameplay and Learning

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Key Summary Points

1 When designing learning games consider how the learning goals can interact with the game goals and how both should be addressed through the game mechanics used in the game.

2 Let the design of the progress toward the game goals make it necessary to engage with the intended learning goals as the player/student works her way through the game.

3 The design of the challenges, rules and feedback are important when implementing and aligning the learning goals with the game goals.

Key Terms

Game goals
Learning goals
Alignment of goals
Design of feedback
Goals in learning and games
Implementing learning

Introduction

"It is a delicate dance between art and science, between instructional design and game design, and between play and guided discovery" (Hirumi, Appelman, Rieber, & Eck, 2010, p. 37).

This chapter introduces goals in games and then potential differences between learning goals and goals in games, as well as the difficulties that may occur when implementing learning goals in games.

What are goals?

To design game goals for a learning game, we should begin by looking at the characteristics of goals and how they are traditionally used in games.

Goals are objectives that a person or a system desires to achieve (Oxford Dictionaries, 2014). In a game, a goal is what we strive for (e.g., goals can be to kill the dragon and rescue the princess). Goals are fundamental to games; they determine what the player has to do to win the game, and give the player a sense of accomplishment and progression. Goals are what a player reaches for in the game and they are traditionally quantifiable, meaning that the goals are entities that can be measured, depending on which goals we use. By making measurable goals, it is possible to tell when the goals are reached. The player will typically know if she has reached the goal through feedback in the game. For example, this feedback can be communicated using trophies, badges, points or unlocked new challenges and goals.

By adding a goal we can make a game out of casual activity. For instance, we can change "doing homework" to a game by stating "the person who finishes her homework first gets to choose what movie to see in the cinema." The goals are often central to the structure of the game, which means that goals are used to purposefully guide the player through the game, as they are the focal point of the player's desire in the game. A useful practice in designing goals is not just having one end goal, but a series of sub-goals that help guide the player. For example, when a player is working her way through the *Rayman Legends* game, she is guided by sub-goals. Examples of sub-goals in one of the challenges are catching fireflies and hearts giving her points and trophies when escaping from and fighting the boss monster, freeing different figures in the game on the way to complete one of the many levels. Here, you can regard the fireflies and hearts as small sub-goals, the aim of escaping and fighting the current boss monster as another sub-goal, the objective of freeing other figures as a sub-goals and the aim of completing the current level as a sub-goal. The overall goal of the game is to complete all the levels and become a hero. In this way all the sub-goals helps to gradually lead her toward the end-goal and also gives her a feeling of progress, thereby keeping her engaged in the overall experience (Fullerton, 2008; Ferrara, 2012).

Goals in a game can set the tone in a game and can also be adjusted to generate particular behaviors, actions, and feelings in a game (Fullerton, 2008). For example, in *Rayman Legends* the goals in the game will make the player run, jump, and stop. It can foster feelings (e.g., fear of the monster or joy of achieving the goal and defeating the monster). When it comes to what you want to achieve in a game you can aim to reach your goal, but you can also have it as your aim or goal to avoid a threat. For example, if you look at a scene in *Plants vs. Zombies,* the aim is not to be eaten by zombies, so your aim in the game is to avoid the threat of the zombies. The goal is to survive the hordes of zombies and kill enough of them within a certain timeframe; thus, the goal is to avoid the zombie attack.

Once we define the goal(s) of a game, we need to develop rules for how to reach this goal, and which obstacles or challenges are necessary to overcome to reach the goal. For example, in *Plants vs. Zombies* if you want to reach the goal of the next level by keeping the specific zombies out of your house at the

current level, you have to plant enough flowers to save up for buying weapons, as well as to choose the right weapons and be strategic in the order and timing of using your protective weapons to be able to survive. Once a game's end-goal is reached, it means the player has won, and he must find a new game with new goals. In a way, winning causes a sort of "death" in the game experience (Koster, 2005).

How are goals in a game different from goals in learning?

There have been examples of games where the learning goals and game tasks are implemented separately, and the learner is rewarded with a small game or puzzle that is entirely separate from the learning objectives of the experience. For instance, a game could involve solving a math problem and then getting to play a short racing game as the reward (Ratan & Ritterfeld, 2009). This approach is traditionally called chocolate covered broccoli, because it hides what is supposed to be "not fun" or unappetizing under something delicious, such as games, while not making a connection between the learning and the fun in the game.

But how do learning goals and game goals differ? The basic difference between the learning goal and the game goal is that the learning goal is the knowledge and intellectual abilities we want the student to learn in the game, whereas the game goal is the actual goal the student/player is striving for in the game. But it will depend on the game how this difference is constructed and how close they come to each other. In some games, the learning goal is not the target game goal, but a means to reach the game goal. For instance, in the game *Citizen Science*, an adventure game that teaches scientific literacy and limnology (the study of freshwater lakes) to schoolchildren, the player's game goal is to restore a polluted lake, Lake Mendota. Through the play of the game, the learner/player gathers information and knowledge to build arguments that can convince people with influence in the game and change the life in the lake. In this way, the game goal is different, but related to, the learning goal. The learning goals enhance scientific literacy and knowledge about limnology, and this practice becomes the sub-goals that are necessary to achieve the larger game goal, which is to restore the polluted lake in the game. By focusing on the ecological needs of Lake Mendota, as well as its surrounding community, the game, through its goals, achieves its learning goals as well (e.g., the understanding and practice real-world issues and scientific practices). Thus, when designing learning games, we need to consider how the learning goals can interact with the game goals, and how the game mechanics support these goals. Game mechanics are what you can do in the game—the combination of actions with rules that produces the game or gameplay (Iuppa & Borst, 2010). For example in *Citizen Science* the designers succeeded in letting the learning goals (e.g., understanding and practice of limnology and how you can work toward saving a polluted lake) interact with the game goal (e.g., saving the polluted lake). The game mechanics support the goals since the rules, possibilities, and challenges in the game are constructed in a way such that the player/learner has to gain knowledge to experience and practice how they can work toward saving a polluted lake (through the non-playing characters (NPCs) in the game). The learning goals, game goals, and the content should be structured in a way that allows for a progressive comprehension of the content of the game (Annetta, 2010). Gee also describes this as "fish tanks" (Gee, 2007). A way to implement the learning goals is to be creating small simplified eco-systems or fish tanks in the

game, starting out with a simplified model of a complex system, making it possible for the learner to interact with the system, and getting to know it little by little, and then letting the game add a bit more complexity along the way ending up with the learner having understood the complexity of the whole system and how it interacts.

The challenges of designing games with respect to learning goals

One of the difficulties about designing according to the learning goals is that the learning goals might not be easy to incorporate into the play of a game. In a learning game, the learning goals are essential. In other words, the learning goals are what are to be experienced, considered, practiced, and reflected upon. Teaching successfully through a learning game will only happen if we succeed in aligning our learning goals and game goals in the game in a way that both addresses the curriculum and keeps the fun of playing a game. This can be challenging, but when the process of learning and achieving competence is designed in a way that is fun in and of itself it can be done (Koster, 2005).

In the development and use of a game for learning in the classroom, it is important to ensure possibilities for implementation of the learning goals in a measureable and controlled way in the game, meaning that when you develop and implement a learning goal you should at the same time consider how this learning goal can be measured and aligned with assessment to be able to evaluate when the learner has reached the learning goal (Hirumi et al., 2010). Thus, considering how the learning goals are implemented in the game enhances the possibility of useful evaluations of learning, such as whether the particular parts of the curriculum were achieved through the play of the game in class as well as the extent to which the games were effective in helping the students learn (Institute of Play, 2014a).

Another challenge is that instructional designers, educators, and game designers construct goals differently. The instructional designer or educator aims to develop a game that helps the students reach the learning objectives. She has the expertise to choose and plan which content and learning activities will support the different learning processes that traditionally lead to the students reaching the learning goals. The game designer, on the other hand, knows how to design the gameplay and the different game elements, such as game mechanics, navigation, interaction, and levels, and how to make everything come together for a fun and interesting experience for the player (Iuppa & Borst, 2010). So where the teacher traditionally is focused on the learning, the game designer has his focus on how to make everything an interesting and coherent experience. The resulting game must be a balance between the aims of these two perspectives.

Case Study One: *Piano Dustbuster*

The *Piano Dustbuster* game from JoyTunes is an example of how piano teaching can work in a game experience. This game teaches children how to play piano, giving them the opportunity to train using their own real piano, using a stealth recording of what you play at the piano and letting the played tones influence the game. In this way there is a seamless integration between what is played on the piano and what is happening in the game. This is an innovative and intuitive way to introduce piano playing to children, which can be used by the children alone or as a supplement to actual piano lessons.

In the game you can choose to play many different songs and they are divided into different popular styles and levels of difficulty. Earning points and stars in the game provide an assessment of your progress. The game is divided between a rehearsal mode and a concert mode. In the rehearsal mode, an old lady in the game tries to sweep away the dust and the player has to help her by hitting the keys on her own piano at the right moment when the different speck of dust hits the piano keys in the game. This interaction will create the melodies played with the correct tones in the correct order at the correct time. The rehearsal mode provides more help than the concert mode; for example, it stops if you miss a tone. In the concert mode you are still sweeping dust and accompanied by an orchestra or a band. This accompanying feature is motivating because it sounds nice, like an entire band when you playing. Though the game will not be able to replace the piano teacher it is a motivating and engaging way of getting to know how to play different tunes. The game's gameplay is "composed" of traditional game elements (Weitze & Ørngreen, 2011), such as:

1. **Action stage:** There is a story with an old lady sweeping dust of the piano keys. And the *stage* in the game is not only inside the game but also "outside" at the real piano.
2. **A goal:** To be able to play a song without mistakes in the right tempo.
3. **Rules:** You have to hit the right keys at the right moment.
4. **Choice:** You can choose what songs you want to play and what style.
5. **Challenge:** You can progress through the different songs with ascending levels of difficulty.
6. **Feedback:** Different kinds of feedback are given, including:
   a. Short-term, as you are at once informed if you have played the right piano key.
   b. Long-term, as you are told how well you performed in different categories (number of right notes, accuracy).

A reward also can be considered as a kind of feedback, as the reward is that you get to play with a "real band" in the game after having practiced. You can also achieve stars when everything works out well for you. This game is a good example of how you can design a game by making it a supplementary motivational tool for learning.
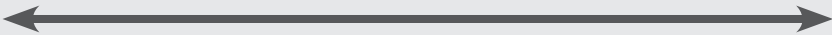
Key Frameworks

In this section, I will cover the two concepts *ludus* (game-like structured goals) and *paidia* (play-like player-led goals), the design of game goals, the design of learning goals and how to align learning goals with game goals.

Clear and measurable goals are often what make a game differ from more ambiguous play activities (Salen & Zimmerman, 2004). This is indeed true for many traditional as well as learning games and is one way to categorize and characterize games. Prensky (2001) has divided learning games into a number of categories showing how different kinds of content, learning activities and subject matters are possible to implement in the different kinds of categories of games. We also have to consider that this way of matching subject matters and game categories when choosing style and shape of the game also to a large degree will dependent on the designer's imagination and innovative talent.

These design choices will influence how the goals in the game are designed. One framework that can be used for revealing characteristics of the game, making it clearer how to design goals, involves placing the games on the axis between the concepts *ludus* and *paidia* (Caillois, 2001). *Ludus* refers to a game that is more goal-oriented with structured rules and objectives. An example of this is *Dragonbox* (2014). *Dragonbox* is a math game teaching children a range of math rules (for example a + 0 = a) in an intuitive way. Here, the subject matter in itself is very rule-based and to reach the sub-goals in the game, the player is both guided as well as discover all the different rules and procedures by exploring the game. On the other hand, *paidia* is a more open-ended kind of playing that involves fantasy, creativity, and improvisation. The goals in *ludus* are structured, specific and measurable and it takes effort and acquisition of skills to reach them. In *paidia*, the goals are more flexible, implicit, changeable, and player-led, like playing in a sandbox. For example, in *Minecraft Creative Mode* (2014) players set their own goals, create their own worlds, and their goals may change as their designs evolve or if they are inspired by the materials or by other players in the game-world (Murphy Chertoff, Guerrero, & Moffitt, 2013). Teachers also use Minecraft in Creative Mode as a learning game where the teachers create the goals and rules according to the subject matter, which moves *Minecraft* toward the *ludus* pole. These different kinds of goals offer different kinds of possibilities for both subject matters as well as for pedagogies when designing games. The possibilities for letting the students decide for their own learning goals in the *paidia* end of the spectrum will for instance harmonize well with social constructivist pedagogies.

Table 1. The spectrum of *ludus* and *paidia*

	Ludus	*Paidia*
	⟵————————————————⟶	
Characteristics of goals	Structured, specific and measurable	Flexible, implicit, changeable and player-led
Game examples	*Dragonbox*	*Minecraft Creative Mode*

Designing game goals

There are a number of methods to use when designing learning games, but when it comes specifically to establish game goals there are not many frameworks—game goals are typically part of the whole game design. Schell (2008) has outlined the qualities that goals should have in the game to make them appropriate and well balanced. The four most important qualities for goals are as follows:

1. Goals should be concrete in a way that makes it clear for the player what the ultimate goal is for the game. If there are a series of goals, these should also be understandable.
2. The goals should be challenging but achievable, letting the player feel that he will be able to reach the goals, so he does not give up.
3. The goal(s) should be designed in a way that both makes the player look forward to the achieving the goal, as well as enjoying having reached the goal. If you have placed the goal after the right level of challenge the goal will be rewarding in itself.
4. You also have to balance the goals in your game in the short- and long-term, and let them relate to each other in a meaningful way (Schell, 2008).

Goals are powerful in games since it is common to use the goals as an indirect control in games. For example, if you have a path splitting in two in a game, you cannot predict which direction the player will take, as she has her freedom to make her own choices. But, if you give the player a goal (e.g., find a new weapon to kill the dragon) and you give a hint about the new weapon being on the left side, then the player most likely will choose the left direction. When you have designed goals that make the player care for the game by wanting to achieve these goals, then you can sculpt the game world around these goals, since the player traditionally will choose to follow the paths that lead toward the goals (Schell, 2008).

Goals or objectives can also be used to help categorize games (Fullerton, 2008). This list of different kind of game goals in different categories of games is for commercial games, but may inspire us for developing game goals in learning games.

1. **Capture:** In capture games the goal is to destroy something that belongs to the opponent and at the same time avoiding being killed or captured. An example of this is *Chess*.
2. **Chase:** In a chase game the goal for player is to elude her opponent if she is chased, or to catch her opponent.
3. **Race:** In a race game, the player's goal is to reach a goal before the other players—the goal being either conceptual or physical in time. It will often be a mix of strategy and chance that determines who wins the race.
4. **Alignment:** In an alignment game, the goal is to arrange the objects in the game in a certain spatial configuration or create conceptual alignment. Examples of this are *Tic-tac-toe* or *Tetris*.
5. **Rescue or escape:** In a rescue game, the goal is to bring a unit in the game in safety. An example of this is *Mario Brothers*.

6. **Forbidden act:** In this kind of game the goal is to break the rules or do wrong moves, such as *Twister*, for example. These games are traditionally not digital games.
7. **Construction games:** In the game the goal is to build, manage and maintain objects. This can for example be *SimCity* or *Minecraft*.
8. **Exploration games:** In exploration games the goal for the player often is to explore the game areas and at the same time collect treasures and solve puzzles.
9. **Solution:** The goals in these games are to solve puzzles more accurately or before the opponents.
10. **Outwit:** The goal in outwit games is to use your knowledge to win over your opponent, for example *Trivial Pursuit*.

If we are using a list such as the above for inspiration when creating game goals in learning games we should be careful not just to create commercial games with learning implemented superficially in the gameplay, but instead reflect on how we can use the different kinds of goals, and also reflect on the quality, integrity and relevance of the goals in a creative way (Belman & Flanagan, 2009). One example of a non-commercial game use of goals can be experienced in the game *Hush* (2007). This serious game evokes a story about a personal experience of a complex historical situation from Rwanda and focuses on a singular, personal experience as a solitary approach to the topic of genocide (Bogost, 2014). *Hush* is created with inspiration from the Values at Play/Tiltfactor Lab's *Grow-A-Game-Cards* (2014). In *Hush* you are a mother and the goal is that you must calm your baby by singing a lullaby (tapping with the right rhythm at the right key). The story takes place during war, and if the mother fails to keep her child from crying, they will be discovered and killed. This is an example of a very different use of goals in a game. The *Grow-A-Game-Cards* are a deck of cards used to inspire game design that incorporate values into play. There are four card categories: challenges, games, values, and verbs. The game designer takes a random card from each category and then uses the combination of cards for a brainstorm on the design of a new game. In the *Grow-A-Game-Cards* (2014) the goals are implicit, in the sense that the goals are to be found in all the different games in the game category. For example if you get the game card, *Go*, the card will tell you, "one player uses black stones, the other white stones. In turns the players "capture" as much territory as possible on a grid lined board." This could be interpreted as a version of a goal from Fullerton's (2008) "capture" category above. When playing or designing with the *Grow-A-Game-Cards,* three card categories, and the specific card, might be:

1. Value: family
2. Challenge: social inequality
3. Verb: wandering

The deck challenges the user to create a game that encompasses the four cards in an innovative way. In a learning game, it would be relevant to use the game goals as a means to make the learning situated in the sense that some of the game goals can be used to make the game relevant compared to where this learning could take place in the real world. For example, we could design a math game that takes place in a shop, where the shop owner has to keep account with how much he is buying and selling on a daily

basis. A goal in this imaginary game may be to earn more than the storeowner next door, and use this as a way to learn basic addition and subtraction. So, when designing game goals it is important to be creative and consider how the game goals can relate to the learning experience.

Designing learning goals

There are a number of methods to use to establish learning goals. In this section I will describe a framework for designing learning consequences for setting learning goals, and then explain characteristics of how learning goals can be defined and designed. Next, I will describe six levels of understanding when mastering the learning goals, and then conclude with an explanation of how to design a progression when implementing the learning goals.

Framework for learning design

Setting the learning goals is a part of the entire design for learning, that is, how you plan to carry out the teaching and learning (Laurillard, 2012). Learning goals are a tool that can be used by the teacher and students to improve teaching and learning, and they should be clear, relevant, realistic and meaningful. Clear learning goals will make it easier for the student to evaluate her own learning process and work. When choosing your learning goals, these goals should be seen in the context of the learning conditions, the setting of the teaching, the educational content, the learning processes and the need for evaluation of the learning all parts of Hiim & Hippe (1997) framework for learning design. All of these elements are intertwined and should all be considered when designing a learning game. Though we aim to design the learning goals in the game, it is also important to consider the following (Hiim & Hippe, 1997):

1. **Learning conditions:** This is the users' prerequisite for learning. What prior knowledge can the learner already be expected to have, or what knowledge does she need to have to be able to reach the learning goals and be a successful learner in the game?
2. **Setting of the learning:** The setting of the game is important, but we also have to be aware of time available and other contextual conditions to meet the learning goals from the curriculum.
3. **Learning goals:** This includes a list of the learning goals, short-term and long-term, to be achieved in the game. It is a highly motivating factor if the students are allowed to be a part of choosing their own learning goals to make them meaningful for the students. These goals can traditionally be seen as a contract between the student and the teacher, that is what they both aim at respectively teaching and learning.
4. **Learning content:** This answers the question: What specific learning content should we choose to make the student able to reach the learning goals?
5. **Learning process:** The learning processes are supported by all the learning activities that we design to make the student reach the learning goals. These activities are determined by the subject matter, but also to a great extent to which pedagogical approaches and learning theories we want to use in the game. The learning theories can be based on behaviorism, cognitive science, social constructivism, constructionism (Dede, 2008; Wu, Hsiao, Wu, Lin,

& Huang, 2012) or experiential learning (Kolb, 1984). Many recent evaluations on research projects evaluating the efficiency of learning games emphasize that we should make a clear standpoint about which learning theory we use when designing games, since this will help in our later ability to measure the effectiveness of the game in helping to reach the learning outcomes (Wu et al., 2012).

6. **Evaluation/assessment:** The point is that we also need to design for evaluation and assessment of whether our learner has reached the learning goal and the growth and mastery we have aimed for in the game. These six points of attention are important to consider when we design our learning game, since this will help ensure that the learner reaches the learning goal.

When designing the learning in the game, the learning goals are what we are aiming for, but the pedagogical approaches will vary depending on the subject matter. If, for example, the learning goal is learning the alphabet, this involves understanding the abstract relationship between symbol and sound, and part of the learning process will involve repetition and memorization, but also reflection and evaluation. On the other hand, acquisition of social skills, for example, will acquire another set of skills, competencies, and attitudes. As in more traditional learning processes outside games, we always have to consider what the student should learn before choosing how she will learn it in a learning game (Kirriemuir & McFarlane, 2006), and thus what kind of learning activities will help the student to achieve the learning goals.

Definition and design of learning goals

The learning goals traditionally capture the three areas: knowledge, skills, and attitudes (Hiim & Hippe, 1997), though some taxonomies prefer to define the third area as competencies (Winterton, Delamare-Le Deist, & Stringfellow, 2006). The knowledge goals describe which knowledge and intellectual abilities the students should learn (Hiim & Hippe, 1997). The skills have a more practical nature and encompass what the student can do with her knowledge and how she can demonstrate her knowledge. The attitudes are learning goals encompassing feelings, attitudes and values (Hiim & Hippe, 1997). Competence is interpreted in many ways but can be interpreted as learning goals covering a combination of the theoretical knowledge and the practical skills (Winterton et al., 2006).

We should aim to design clear learning goals to make it easy for the student to comprehend what she should learn and to make the learning goals easy to evaluate after the learning process for the teacher. One way this is done is by making the goals observable, so we can see if the student masters the learning goal. This is often obtained by applying action verbs in the formulation of the learning objectives. An example of this is, "after playing [a specific game], the student should be able to [recognize/ demonstrate/ calculate/ decide/ evaluate/ formulate] [a fact, concept, topic, theme, task, activity, or skill] (Hiim & Hippe, 1997). A way to start formulation learning goals is to end the sentence: "After playing [this game] you should be able to [blank]."

A commonly used taxonomy of cognitive complexity was developed by Bloom (1956). In the slightly revised version (Anderson & Krathwohl, 2001, p. 67-68), the model describes six levels of understanding and mastering the learning goals, formulated as the students thinking according to the cognitive levels of complexity. The ascending levels are: remembering, understanding, applying, analyzing, evaluating and creating. Designing the learning objectives with these different cognitive levels in mind will give an overview of how and at which level we expect our students to be able to master the learning goals, and these levels will also help making the learning goals more simple to measure when we evaluate what has been learned in the game and at what level of cognitive rigor (Hess, Jones, Carlock & Walkup, 2009). When studying a subject such as human rights, the specification of the cognitive levels when designing the learning goals will make it possible to measure if the student only is able to remember basic human rights or if she is able to apply and use human rights concepts for analyzing complex social situations.

Progression in the choice of learning objectives in the game

When designing learning goals you should also be aware of the progression in the learning to make the goals attainable. Learning progressions within a content area begin at the novice level with the core concepts and skills as the learning goals; these core concepts and skills are considered fundamental. To progress through a content area to reach the learning goal, every learner needs to master these core competencies. For example, you could say that the student must learn and master the rules and procedures within each learning topic to achieve the learning goal (Dreyfuss, 2001). This is one of the things that successful computer games do very well. As the student has acquired the knowledge or the learning goals in the novice level, the rules and skills are integrated into each other, and you can begin to let the student get to know more complex relationships within the current topic, higher learning goals as in Bloom's taxonomy of cognitive complexity. In education, it is important to take the student's zone of proximal development into account (Vygotsky, according to Santrock, 2008). This zone is located between the student's actual level of development and the potential development. You need to support and scaffold the implementation of the learning goals and slowly begin to "remove the scaffolding" until the student is able to work on his own at the current level of competence. This should be followed by the next level in the new zone of proximal development, and in this way he will progress in an expanding cycle, reaching new learning goals progressively.

Aligning game goals with learning goals

There are a number of different methodologies for aligning game goals with learning goals. I will start by describing the *Q Design Pack for Games and Learning,* then Whitton's recommendations for implementing learning in games, then The Smiley Model, which explains how the game elements in this model relates to the learning goals.

One methodology for aligning game goals with learning goals is by the Institute of Play and described in their book, *Q Design Pack for Games and Learning.* This book explains that, "All effective classroom games are designed with specific learning goals in mind. Before you can design games focused on

specific learning goals, you need to learn about game design" (Institute of Play 1, 2014, p. 11). Learning goals and game goals can be aligned by providing a practice space for goal-oriented challenges. For example, in the game *Dragonbox* (2014), the student/player is provided with a practice space in which she can gradually move through the challenges, explores and solve the puzzles reaching the game goals and learning goals of each level.

The *Q Design Packs* offer a framework to develop learning games and within this frame it is central to help align game goals with learning goals (Institute of Play 1, 2014; Salen, Torres, Wolozin, Rufo-Tepper, & Shapiro, 2011). To align game goals with learning goals, we first generate ideas with the learning goal in mind, while also considering how to assess these goals during and after gameplay. This is based on backward planning, which means knowing your students learning goals, and the final assessment before planning the individual lessons and activities (Wiggins & McTighe, according to Institute of Play 1, 2014). This is followed by an elaboration of the game design comprising an overall mission with an overall game goal and several quests with sub-goals on the way to the end goal. At the Institute of Play, the students have used this framework for making their own learning games.

Whitton, in *Learning with Digital Games* (2009), states that for a learning game to be a successful learning tool, it should be designed in a way that ensues that the game goals support the learning goals. Whitton suggests creating a list that describes the intended learning goals, followed by a description of the traditional learning activities that would lead to the student achieving these learning goals. Then, this should be followed by a process of deciding which learning activities can be modified or embedded within a game, as things we can do in the game. Whitton does not directly mention the role of the game goals in this design process.

There are many attempts to design frameworks for educational game design (Winn, 2008; Staalduinen & Freitas, 2011). The Smiley-Model is a game design model describing how to design engaging learning games (see Figure 1) (Weitze & Ørngreen, 2011). The model addresses how to design the learning and how to implement the learning elements into the game while at the same time always considering how to make the game motivating and engaging. The Smiley-Model uses the Hiim & Hippes (1997) learning design framework described above for the learning design (Weitze & Ørngreen, 2011).

In the Smiley-Model, the game goal is one of the six game elements you can use when you want to "set the learning design into play" (Weitze & Ørngreen, 2011). The five other game elements are: 1) action space, 2) rules, 3) choice, 4) challenge, and 5) feedback. All the game elements are intertwined and thus, the game goals are strongly related to the other game elements, when designing a learning game.
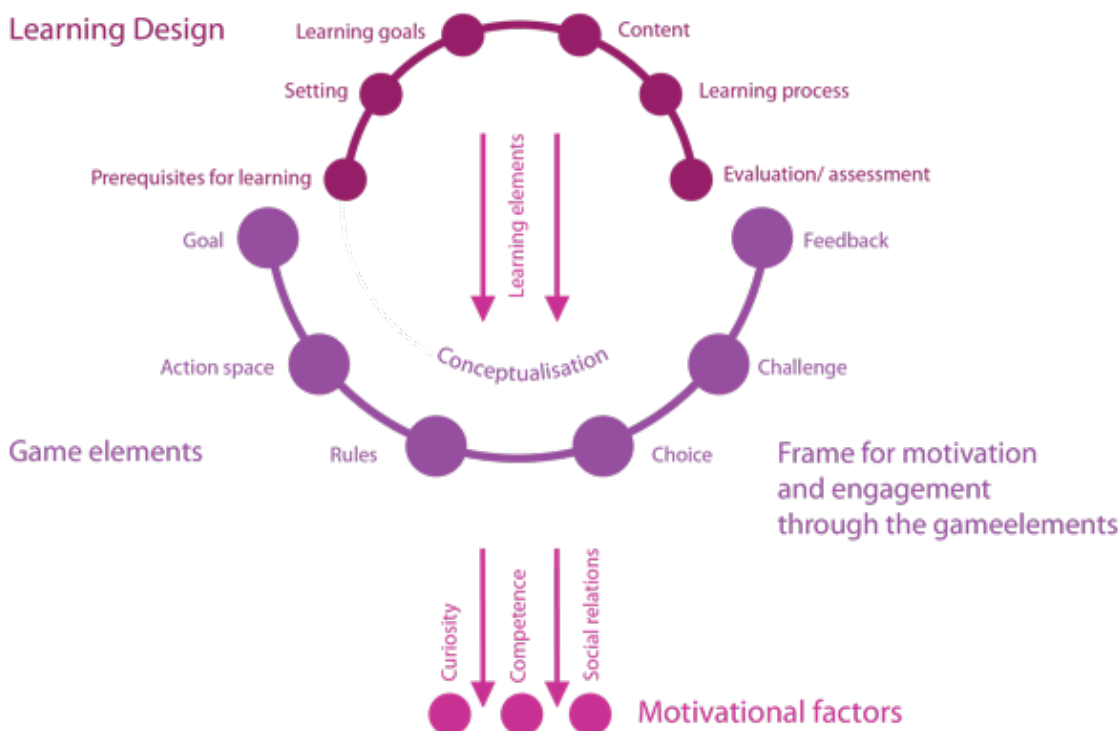
Figure 1. The Smiley Model. (Weitze & Ørngreen, 2011).

Because the game goal differs from the learning goal, we need to consider how we actually implement the learning objectives in the game. The game mechanics, or which actions can be taken in the game, what we can do, provide the structure to the game.

If all the game elements are intertwined, where are the learning goals found in a game? The "challenges" in a learning game should be encompassing the learning goals, the learning content, and the learning activities. For example, challenges can be, patterns you have to recognize, rules you have to learn, tasks that should be solved, and hand-eye coordination to be learned (Koster, 2005). The framing of the learning goals should determine which challenges are appropriate to include helping to meet the learning goals. For example, when playing a learning game the purpose is to attain the learning goal and to learn to master the action or to understand the pattern. By playing the game successfully, the learner will automatically show her competence when overcoming the challenges, since completing the game would require that she knows how to solve the problem. If the student/player finds it difficult to meet the challenge in the game, the game should provide feedback or scaffolding, breaking down the task into smaller game goals to support the player.

Koster (2005) suggests that challenges can be patterns or skills you have to learn, and similarly, Gee (2005) suggests that it is possible to use skills as strategies in games. Gee (2005) explains that you can design learning in a way that lets the learner practice a skill (this skill being part of the learning goals) as part of a strategy to accomplish the game goals she wants to accomplish. In this way, the learner will feel like the practicing process is part of a strategy to accomplish her game goal, removing the attention from the traditional boredom that occurs when practicing the same thing over and over again.

When implementing learning elements into the game and in this situation observing and designing the connection between the game goal and the other game elements in the Smiley-Model the player will make some "choices" in the game and the "rules" are determining when the game goals are reached or not reached. If the learning goals for example are to learn algebra in the *Dragonbox* game, the "rules" at the same time are a big part of the learning process since they are making the student/player reach the "learning goals" by letting her train "basic memorization" and even reflexes, by doing the same thing over and over if she does not succeed the first time. This learning will happen while the student is working her way through the game (Flanagan, Hash, & Isbister, 2010).

Moreover, the 6th game element "feedback" is crucial to let the student/player know if he has reached the goals and to assure that learning has occurred (Table 2). In fact, feedback in the game corresponds very well with the feedback that is needed when learning (Murphy et al., 2013). If "short-term feedback" in the game is given within one and a half seconds on the action taken (Wilms, 2011), research suggests that this will give the student/player the opportunity to experience the feeling of "learning by doing," meaning developing and learning as a result of first-hand experience (Chatfield, 2010; Kirriemuir & McFarlane, 2006). If the player does not fulfill the learning goal he should have "feedback." The "long-term feedback" given in a game should be more instructive and can provide guidance and strategic feedback (process-feedback) (has resemblance with formative feedback in learning) or give information on action/performance-based data (outcome-feedback), which then will lead the learner toward the learning goal (Sanchez, Cannon-Bowers, & Bowers, 2010) (For more details on feedback, see Murphy et al., 2013).

Table 1. Feedback on the sixth game element in the Smiley Model

Feedback		Characteristics
Short-term feedback		Within 1,5 seconds on the action taken, enables the experience of "learning by doing"
Long-term feedback	*Process feedback*	*Instructive, provides guidance and strategic feedback*
	Outcome feedback	*Performance-based data*

In the game development process and when the game is tested you have to alter, add and adjust the different game elements to improve the game and reach both the learning goals as well as the game goals (Schell, 2008).

Case Study Two: *Re-Mission 2*

Re-Mission 2 is a game for young people with cancer developed by HopeLab, a research and development nonprofit company. *Re-Mission 2* consists of six small games and the aim is to help young people with cancer fight their disease. The learning goals are to teach young people to stick to their treatments and shift attitudes about chemotherapy since these two elements are important parts of a successful treatment that helps to fight cancer. The game aims to motivate the players to stick to their treatments by boosting self-efficacy and building positive emotions in the players.

For children, a problem with cancer treatment is that it is a very rough treatment both physically and psychologically. The children sometimes feel more ill after their chemotherapy treatment, and therefore, at times it feels like they are hurting themselves more by sticking to the treatment. But this treatment will help them fight the disease, and therefore it is crucial that the children work with and not against the treatment. The knowledge about the disease and treatment is normally given by doctors as written information and is difficult for the children to understand and learn. The game has been developed by medical professionals, game developers, and young patients and has been designed so the children learn about what is going on inside their bodies when cancer attacks. The game also gives the children an idea of what power they have in defeating cancer.

The learning goals and game goals are aligned in *Re-Mission 2*. For example, the learning goals are:

1. That cancer can be defeated.
2. That you have different kinds of possibilities to take an active part in defeating cancer.
3. What is going on inside the body when cancer is attacking and how the different kinds of medical treatments work.
4. That the body has weapons and there are also medical weapons that can be used to fight cancer.
5. That there are different kinds of cancer cells more and less aggressive, so you have to attack them in different ways.

In the game, the player is put inside the human body to defeat cancer, being able to use weapons such as chemotherapy, antibiotics, and the body's natural defenses. The overall goal is to defeat cancer and there are different sub-goals inside each game.

In the game *Nanobot's Revenge* in *Re-Mission 2*, the mission and game goal is to defeat the Nuclear Tyrant and his forces. The player is the powerful microscopic robot Nanobot designed to blast away cancer and the mission is to prevent the cancer cells completing the tumor and stop the tumor from reaching the blood stream. The goal is thus concrete, achievable, and is designed in a way that makes the player look forward to achieving them. The game goals also give the player an opportunity to feel that he achieves competence, autonomy, and control when being able to defeat the Nuclear Tyrant because he is learning what it takes to kill the bad cells. There are nested goals in the game, since there are different kinds of challenges with enemy-cells to be defeated at the different levels in the game—all

representing different kinds of cancer cells having different kinds of ways to build cancer and resist the players' attacks. The player, on the other hand, has different kinds of weapons with which to defeat the bad cells (e.g., chemo, radiation, antibiotics) and the rules in the game determines if you beat the Nuclear Tyrant and his forces (e.g., some of the bad cells can only be defeated with specific kinds of treatment). The sub-goals make it easier for the player to understand the game and experience small successes while managing the different challenges. The game is thus designed so the learning goals are implemented in an overall mission with an overall game goal and several sub-quests with sub-goals on the way to the end goal. By playing the game with progression toward the game goals, the player is learning what is going on in the body when cancer is attacking, experiencing that he has the power to use the different kind of treatments to fight the bad cells and is engaged with the intended learning goals while playing the game.

The research suggested that playing *Re-Mission* (the first *Re-Mission* game with a gameplay that resembles *Re-Mission 2*) significantly improved key behavioral and psychological factors associated with successful cancer treatment and that the game had an impact on the biological level as well (Kato, Cole, Bradlyn, & Pollock, 2008). The players showed a faster increase in self-efficacy and also showed a faster acquisition of cancer-related knowledge. The results indicate that *Re-Mission* successfully reached its learning goals through the game goals, giving a positive impact on the young peoples health behavior. Furthermore, another study showed that the fact that the young people with chronic illness was actually playing the game instead of just watching someone else playing the game is the main reason for the activation of the brain's positive motivation circuits, supporting earlier findings suggesting that *Re-Mission*'s effectiveness stems from its impact on individual emotional and motivational processes. The impact on the emotional processes leads to a shift in the young people's attitudes and emotions, which helps boost the players' adherence to the prescribed chemotherapy and antibiotic treatments (Cole, Yoo, Knutson, 2012). The *Re-Mission* games have thus successfully been able to align learning goals and game goals.

Key Findings

In this section, I discuss research on findings in game goals and describe Hirumi et al.'s (2010) experiences with implementing learning goals in the game.

Research findings on game goals

The game goals should be motivating, and this will happen if they arouse curiosity, and provide a sense of competence, autonomy, and control (Weitze & Ørngreen, 2011). If you give the player an opportunity to choose and adjust her own goals, research suggests that it will enhance feelings of freedom, autonomy and give her the possibility of targeting special interests (Deci & Ryan, 2000).

Game goals should be presented in a way that ensures that a structured flow of goals following and nested inside each other will pull you through the game. This means presenting a long-term goal or overall goal (e.g., rescue the princess and become a hero), and medium-term goal (e.g., kill level the dragon) and the short-term goals (e.g., collect jewels for the princess). These goals are nested such that the small goals help progress and guide the player toward the larger goals. Larger and smaller goals can be achieved throughout the game (Deterding, 2011). Splitting game goals into many small and large goals will help to provide a sense of having many small successes for the player (Chatfield, 2010). It is also important to link the goals to each other in a meaningful way so the game can be experienced as coherent (Schell, 2008).

Implementing learning goals in the game

Instructional designers may know little about game development and on the other hand game developers often may know little about training, education and instructional design. Therefore, it sometimes might be difficult to work together for the two professions, being able to use and realize the potentials of both game and learning (Hirumi et al., 2010; Iuppa & Borst, 2010).

Some of the differences for learning designers and game designers can be described like this: For game designers the goals and outcomes are important, but goals are only secondary to the gameplay itself (Koster, 2005). For the learning designers goals, outcomes are very important and have a high priority. The game designer will prioritize an engaging gameplay, perhaps sacrificing veracity and coherence. This might seem to be happening in the wrong order but in learning games the goals are not more important than an engaging gameplay. Instead the learning goals and game goals are more like "anchor points on intersecting continua" and not opposed concepts (Hirumi et al., 2010, p. 32).

On the other hand the learning game designer should not ignore the learning goals and it is important to choose appropriate educational strategies and plan for assessment in the game. Hirumi et al. (2010) suggest that the key lies in finding ways to incorporate gameplay into our objectives, and to design effective learning into gameplay design. If the game is not fun, a game designer will often try to find a way to solve that situation at once, without playing the same full attention to assure that the learning goal is met. The learning goals do not have to be represented explicitly in the game, but we can aim to align the desired learning outcomes with the game outcomes, and at the same time aim to facilitate learning and engagement (Hirumi et al., 2010).

Game designers and learning designers need to work together and understand each other's perspectives. The game designers will design challenges, quests, obstacles and puzzles at the same time deciding for the conditions for progress and mastery. The learning designers on the other hand can elaborate on the "Learning Task Maps," specifying the skills that will be needed to achieve the overall goal. The game and learning designers then move on to specifying the context, behavior, as well as the criteria for mastery of each challenge or skill. In a learning game, the evaluation and feedback in the game has to include evaluation of the learning goals. On the other hand, the learning designers have to learn

and understand that evaluation has to be imbedded in the gameplay, and that this might change the traditional strategies and sequence of learning as well as some of the challenges and strategies in the game may go beyond traditional achievement of the learning goals.

What is actually learned in the game?

The aim is to design the game in a way that enables the player to reach the learning goal as well as the game goal. To do this, we should also consider the difference between the two (Staalduinen & Freitas, 2011, p.44):

1. What the player can learn in the game, that is, what the game's creator has intended in the design concerning learning goals.
2. The skills and topics the player must learn to be able to finish the game. This should partly be the same as what the player must learn in the game.
3. Things that the player actually has learned after playing the game.
4. Collateral learning: This is what the player learns in the game that was not directly intended or just was not connected directly to the subject matter.
5. "Cheats" or the things the player has learned in the game, often by taking short-cuts or exploring the game, but sometimes a consequence of this also is that the student skips over the intended learning in this process (Staalduinen & Freitas, 2011, p. 44).

No matter how thoroughly you plan your implementation of the learning goals and align them with the game goals, you need to playtest your game with real students to see if your intentions came through.

Assessment Considerations

In learning games assessment has an important role, since we want to be able to investigate if the student has achieved the learning objectives while playing the game. Feedback in a learning game is essential, since the possibility to give individual informative feedback to the student is one of the advantages of learning games. Games should be able to gather data from the learner and give direct, useful and relevant feedback, telling the student where he is in the learning process and where he should consider going next. We need to decide how the learning objectives will be measured in the game and how student performance will be evaluated to provide actionable and relevant feedback and support student self-reflection (Wilson, Bejar, Scalise, Templin, Wiliam, & Irribarra, 2012).

Likewise, a teacher needs to set the learning objectives, select content appropriate for reaching the learning objectives, design appropriate learning activities, and after having conducted these activities, observe and evaluate/assess the obtained learning of the students, followed by giving helpful feedback to the student afterward (Hiim & Hippe, 1997). The same type of process needs to be integrated into the game's design.

Evaluation should happen in the game as well as around the game. Staalduinen & Freitas (2011) distinguishes between three kinds of player assessment in games:

1. **Post-game assessment:** Here the teacher tests after the game with a written or oral test examining what the student has learned. This is not really a part of the game, but can be a good way to test if the teacher has used a commercial game for learning.
2. **Post-game debriefing or evaluation:** This kind of assessment is an evaluative talk between the students/players and the teacher about which experiences they have had in the game. (Staalduinen & Freitas, 2011).
3. **In-game feedback:** The game measures progress, achievement, and scores (long-term feedback), that is feedback on the player's actions in the game (Staalduinen & Freitas, 2011; Wilson, Bedwell, Lazzara, Salas, Burke, Estock, Orvis, & Conkey, 2009; Salen & Zimmerman, 2004).

Learning is situated inside learning games and therefore the assessment also can be designed to happen continuously within the narrative context of the game. This can both happen with short-term goals (e.g., by solving the puzzle and moving on in the game), and long-term goals (e.g., by solving all the challenges and reaching the final goal). Successful performance is therefore not necessarily communicated as it is in traditional teaching (e.g., giving marks), instead assessment in games is happening as part of the story through real (game) world consequences (e.g., you unlock new challenges, you move to another part of the world, you level-up when having solved one of the learning goals). In this kind of in-game assessment it is important to understand the difference between assessment in games and in traditional teaching and design in a way such that the learning goals also take the game context into account (Hirumi et al., 2010).

It is important that we create a supportive environment for learning (Wiliam, 2012). When we give feedback in games, we basically either tell the student if her current performance has reached the goal or has fallen short on the goal. Our wish is that the student's response is increased effort and aspiration toward the learning goals. If the feedback gives the learner a feeling that she might fail while many others has succeeded, she might be disengaged, deciding that it is better to be thought lazy than dumb, and thus she does not continue the progress toward the learning goal. Thus, to increase the likelihood of a productive student response you should:

1. Make the game a safe place to make mistakes.
2. Let the feedback effectively convey the idea that everyone can become smart. If the learner does not feel smart, then he is just not smart "yet."
3. Provide the learner with the support needed in a way that acknowledges that we do not all learn the same way, and that is okay.
4. Enable the student to focus on the comments and details of the feedback, and not on the scores.
5. Give useful feedback only focusing on the subjects that the learner can change.
6. Give feedback in a way that gives space and place for the learner to improve the results.

Future research

There is little research to be found on how to align the learning goals with the game goals, therefore the field of learning games can benefit from further research in this area, since a number of studies confirm the importance of aligning the learning goals with what can be learned in the game (Gee, 2011; Wilson et al., 2009) and the need of frameworks for doing this (Akilli, 2007). There have been many pedagogical approaches when designing game-based learning (Wu, et al., 2012; Kebritchi & Hirumi, 2008), for example, behaviorism, cognitivist or constructivism. To be able to assess the variables in a successful learning game, we should define which learning theories are behind the design of the game, since this will give an opportunity to measure the pedagogical components, among these the learning goals, and later repeat the success in other learning games. Dede (2011) recommends establishing common research strategies and models for educational games to aim at making studies that complement each other in what and how they explore. One way to research how to better align learning goals with game goals is to observe and analyze the conditions of when learning games are successful at providing an effective learning environment for the students and then take the following into consideration: the pedagogical approach, the curriculum, the subject matter, the context, and the characteristics of the students, teachers in the learning situation in question, and mapping these variables that are in every learning situation (Dede, 2011). This will be a better way of researching instead of aiming at universal frameworks, which will work in every condition since no educational approach and no educational technology will be universally effective. Then, we might be able to take all the necessary parameters into consideration when aiming at embedding the leaning goals into the game's goals and game's mechanics.

Case Study Three: Research Labs

A number of research labs and centers are dedicated to the study of implementing learning into games and how to assess the learning in and around the game.

Glasslab at Institute of Play has developed *SimCityEdu* (2014) a *SimCity*-based learning tool that allows teachers to make use of the already provided lesson plans or to design their own lesson plans inside the game. In *SimCityEdu*, students can explore the simulations created in the city. For example, there is a challenge on how to bring the air pollution down, and at the same time keeping the employment up, letting the students experience the complex consequences of their choices within a complex system. In the game, the students can play the role of a mayor, responsible for the challenging work of addressing environmental impact, while at the same time balancing the employment needs and the happiness of the citizens in the city. In *SimCityEdu*, the students have individual learning experiences, and the game aims at improving the learning process by providing formative assessment of the learning goals. The teacher can access information about the students' ability to problem solve, read, and explain the relationships in complex systems.

Institute of Play has recently released a whitepaper on how to assess student learning by formative assessment as well as by using gameplay data, proposing a design approach that links the process of game design with the process of assessment design (Mislevy, Oranje, Bauer, Davier, & Hao, 2014). This paper describes some of the thoughts behind the continued elaboration of *SimCityEdu* and the work on developing standards for game-based assessment.

The *SimCityEdu* game is built so the teachers can create their own lesson plans encompassing learning goals, and teachers and students also have access to dashboards that give an overview. Glasslab has developed lesson plans for *SimCityEdu*, which teachers are free to use. For instance, one of the units in the physical science-based lessons is called "Power to the People." This unit deals with energy consumption, cost, and consequences and is designed for grades six through eight. This specific lesson ("Power to the People") lasts 5 days with 45-minute lessons, with the students studying fossil fuels, nuclear power, solar, and wind energy—all renewable energy sources. The students have to create an energy system grid in their city in the game to supply power to everything that they build. In the game they will experience that there are real-world consequences according to the choices they make in the game, giving them opportunities to reflect on these consequences. A teacher can see the learning goals that the students will be working with on all five days and there is also a list of essential questions that the students should be able to answer after playing the game. The assessment takes form as formative assessment, both 1) outside the game in the discussions in the class, as well as 2) inside the game, since to make some of the right choices in the game and move on in the game, the students have to understand part of the knowledge in the curriculum. But the teacher can also choose to use the designed 3) pre- and post-assessments in the game to get an idea (summative assessment) of what the students has learned in the game.

Best practices

The following is a list of best practices for aligning game and learning goals.

Game goals

1. **Goal qualities:** The goals should be concrete, achievable and designed in a way that makes the player look forward to achieving them.
2. **Sense of control:** The goal should provide a sense of competence, autonomy and control as well as arouse curiosity.
3. **Many small and large goals nested in the game:** Make a meaningful and structured flow of nested goals in the game, from short-term to long-term goals by letting the small goals help progressing and guiding the player to the larger goals. This will give an overview in the game and provide a feeling of many small successes.

Integrating game goals and learning goals

1. **Backward planning:** Designers need to know the student's learning goals and the method of assessment before planning the individual lessons, activities and game goals.
2. **Elaborate missions and quests:** Use the learning goals to determine the game design, which should comprise an overall mission with an overall game goal, and several sub-quests with sub-goals on the way to the end goal.
3. **Engagement with learning goals:** Let the progress toward the game goals necessitate engagement with the intended learning goals.
4. **Embed the learning activities in the game**: Let the learning activities be modified or embedded within the game.
5. **Challenges:** The challenges in a learning game comprise the learning goals, the content and the learning activities. When overcoming the challenges in the game, the learner will show her competence since this requires that she know how to solve the problem and attain the learning goal.
6. **Purpose of the challenge:** To reach the learning goal and to learn to master the action or to understand the pattern you have to recognize, skills or rules you have to learn, tasks that should be solved, and hand-eye coordination to be learned.
7. **Game goals and rules:** The rules should help determine if the game goals are reached or not reached.
8. **Connection between the learning process and rules:** The rules might be part of the learning process, helping to meet the learning goal. This can, for example, be designed in the game by letting the rules and goals invite the player to repeat or retry the task until the challenge is solved.
9. **Goals and feedback:** Feedback gives the student/player a possibility to know if he has reached the learning, as well as the game goals, thereby helping to ensure learning and transfer.

Resources

Books

Ferrara, J. (2012): *Playful design.* Rosenfeld.

Fullerton, T. (2008): *Game Design Workshop.* Morgan Kaufmann.

Gee, J.P. (2007): *What videogames have to teach us about learning and literacy.* Palgrave Macmillan.

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Games and Tools

Breakaway (www.breakawaygame.com)

Citizen Science (www.gameslearningsociety.org/project_citizen_science.php)

*Construct 2 (*www.scirra.com)

Dragonbox (www.dragonboxapp.com/index.html)

Gameglobe (www.gameglobe.com)

Game maker (www.yoyogames.com)

Gamesalad (www.gamesalad.com)

Games for change (www.gamesforchange.org/2011/02/breakaway-a-soccer-game-about-gender-violence/)

Grow-A-Game-Cards (valuesatplay.org/grow-a-game-overview) and (itunes.apple.com/us/app/grow-a-game/
        id657244924?ls=1&mt=8)

Hush (valuesatplay.org/play-games)

Institute of Play (www.instituteofplay.org)

Kodu (www.kodugamelab.com)

Minecraft (minecraft.net)

MinecraftEdu.com (minecraftedu.com/wiki/index.php?title=Teaching_with_MinecraftEdu

*Piano Dust Buster, Joy Tune*s (www.joytunes.com/piano/)

Plants vs. Zombies (www.popcap.com/plants-vs-zombies-1)

Rayman Legends (rayman.ubi.com/legends/en-gb/home/)

Scratch (scratch.mit.edu)

SimcityEdu (www.instituteofplay.org/work/projects/simcityedu-games/)

Values at Play/ Tiltfactor (valuesatplay.org)

Unity (unity3d.com)

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