Chapter 7
Gamification Framework

Quest
Let's try to understand the gamification framework.
Let's think of the role of the story for gamification.
Let's see the use for mechanics and how the mechanics can be used in games.
Let's try to understand the technologies for gamification and how they can be used in education and learning.

7.1 Gamification Framework for Education and Learning

There exist different views on the framework for games and gamification. This chapter begins with the introduction to gamification frameworks and elements for games. Hunicke, LeBlanc, and Zubek (2004) and Zichermann and Cunningham (2011) have suggested a theoretical gamification framework, which is the MDA framework, consisting of mechanics, dynamics, and aesthetics (see Fig. 7.1).

Mechanics are the components implemented for a game. With data and algorithms, mechanics define the behaviors allowed to the gamer and the control mechanisms of the game. In Monopoly, for example, the mechanics include dice, mortgage, title deed, and jail.

Dynamics define the interactions with the mechanics. It is the observable behaviors that gamers enact while playing a game. Taking ownership of a property can be one of the dynamics in Monopoly. Forming an alliance can be a good example of the dynamics in real-time strategy games or multiplayer online battle games.

Aesthetics describes the feeling and emotions that the gamer can experience from playing a game. It is the emotional response that game designers try to create in the gamers. It can be created by mechanics and dynamics. Sensation, fantasy, narrative, challenge, fellowship, discovery, expression, and submission can be the examples of aesthetics (Hunicke et al., 2004).

S. Kim et al., *Gamification in Learning and Education*, Advances in Game-Based Learning, DOI 10.1007/978-3-319-47283-6_7

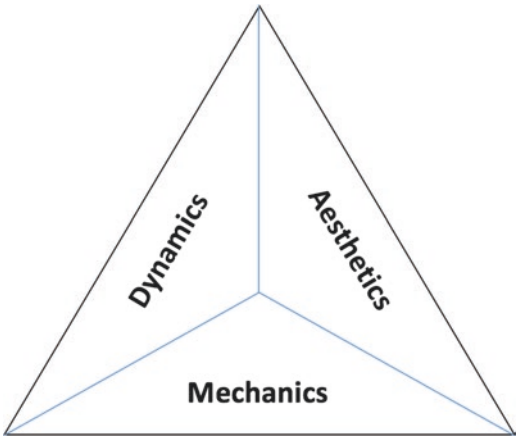

Fig. 7.1 MDA framework

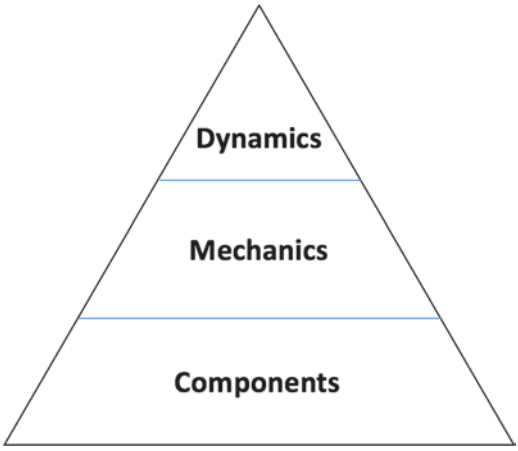

Fig. 7.2 Werbach and Hunter's gamification framework

Another view on the gamification framework has been proposed by Werbach and Hunter (2012). The researchers classified the gamification elements into dynamics, mechanics, and components (see Fig. 7.2).

Dynamics is the most abstract concept and biggest picture in a game or gamified system. It can be defined as the goals and objectives of an organization. Dynamics is comprised of five elements: constraints, emotions, narrative, progression, and relationships.

Mechanics are necessary for implementing dynamics in a game. It is the element that promotes gamers to engage in the game and behave as planned by game designers. Mechanics is comprised of ten elements: challenges, chances, competition, cooperation, feedback, resource acquisition, rewards, transactions, turns, and win states.

Components are the substantiated form of dynamics and mechanics, the least abstract element, and the closest element to the actual game or gamified system. There are 15 gamification components: achievements, avatars, badges, boss fights,

Fig. 7.3 Schell's gamification framework

collections, combat, content unlocking, gifting, leaderboards, levels, points, quests, social graphs, teams, and virtual goods.

The gamification framework of Bunchball (2016) is simpler than the other frameworks we have talked about so far. In the framework of Bunchball (2016), there are two elements: dynamics and mechanics. Bunchball (2016) defined *dynamics* as a gamer's experience attained through a game and *mechanics* as gamification elements required for providing gamers with the experience. Dynamics includes reward, status, achievement, self-expression, competition, and altruism. Mechanics includes points, levels, challenges, virtual goods and spaces, leaderboards, gift, and charity.

Schell (2014) defined four game elements: story, mechanism, technology, and aesthetics (see Fig. 7.3).

Story is a course of events that gamers can experience while playing a game. The story in a game can be developed in a linear structure or a branching structure. Story can be effectively delivered by the aesthetics and technology.

Mechanism describes the rules and procedures for a game. It defines the gamers' behaviors, rewards, and penalties in a game. The rewards and penalties affect the development of a story. There is no mechanism in novels, movies, and dramas since readers or audience cannot intervene in the story development.

Technology means situations, materials, and hardware required for creating a game. Many games employ information technologies. The technology, however, can also be a sheet of paper, a pencil, a Monopoly token, or other objects that we can see in our daily lives.

Aesthetics decides the look and feel that gamers can perceive within a game by audio and visual elements. Aesthetics directly influences gamers' experiences. Gamers can have a different experience from the stories that have different aesthetics, but the same story and mechanism.

There are some differences between terminologies in research, but the meanings of the terminologies are similar between research. This book employs an integrative gamification framework based on the research reviewed in this chapter (see Fig. 7.4).

Story provides a pivotal process leading an educational program. It consists of educational objectives and stories related to the objectives. Story can be divided into

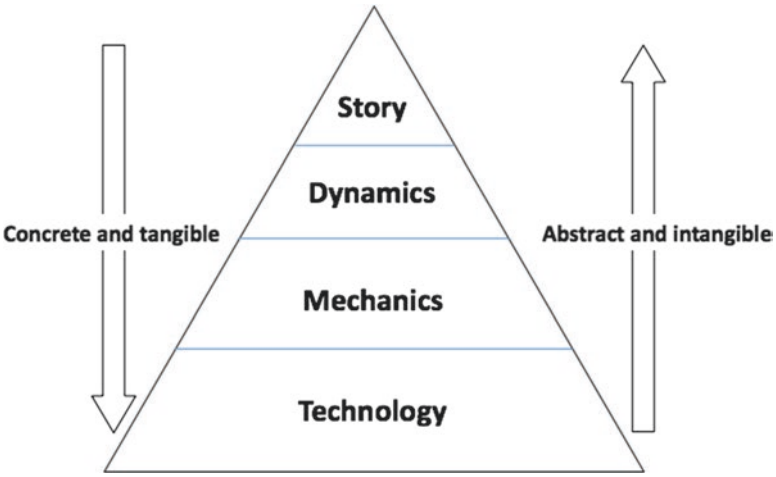

Fig. 7.4 Integrative gamification framework

various fun aspects. Dynamics, consisting of 20 fun experiences of PLEX, gives learners fun derived from the story. The purpose of the dynamics is to motivate learners to engage in learning. Mechanics implement dynamics at the level of data and algorithms. There are elements that learners can directly recognize in a game or gamified system. Learners receive feedback and rewards through the mechanics. Leaderboards, points, and badges are good examples of mechanics. Technology makes mechanics tangible and visible to learners. Learners can interact with a game or gamified system through technology. Technology in gamification includes hardware, software, network, and other objects.

7.2 Story

Most games intrinsically include stories. The story in gamification is not much different from one in novels, movies, or dramas. A difference is that gamers can intervene in and interact with a game, but the other genres do not allow audience to make changes in the development of a story. A gamer can decide if he or she will be a good entrepreneur or a greedy businessman in a game. While playing a game, gamers are exposed to a variety of options that require them to select a specific option to make progress in the game. Depending on the decision, a gamer can proceed to different story branches even though the gamers are all playing the same game.

Story strengthens the level of immersion and provides adventures and fantasy that people cannot experience in their daily lives. Story plays a role of the center axis that integrates fun experiences in a game. Gamers can experience adventure, competition, discovery, or other kinds of fun aspects planned and arranged to support the story in a game. Because of the story, gamers may continue thinking they are playing the game even when they are taking rest.

7.2.1 Origin of Story

Some games use stories that are developed specifically for the game, some adopt existing stories or modified versions of them. People may be familiar with the novel, *Gulliver's Travels* (Swift, 1726). A part of the novel talks about Laputa, which is an island floating in the sky. Laputa is made of advanced technologies. Grandville illustrated Laputa in 1856 (see Fig. 7.5).

Laputa appears again in the animated motion picture, *Castle in the Sky* (Takahata & Miyazaki, 1986). The Laputa image in the animation looks similar to the illustration in *Gulliver's Travels* (Swift, 1726). The appearance of Laputa does not stop here. Laputa turns up again in the Nintendo game, *Legend of Zelda: Skyward Sword* (Aonuma & Fujibayashi, 2011). Gamers in this game visit islands in the sky and solve problems that the residents on the islands have. There are shops selling equipment including bows and shields on the islands. Gamers can see forests, volcanos, deserts, or other backgrounds of the place. The names of the islands in this game are

Fig. 7.5 Laputa in Gulliver's Travels illustrated by J. J. Grandville (Reprinted from Wikimedia Commons, retrieved from https://commons.wikimedia.org)

not Laputa, but gamers who have read *Gulliver's Travels* (Swift, 1726) or watched *Castle in the Sky* (Takahata & Miyazaki, 1986) most likely notice the similarities.

The story of the video game *Transformers* (Hayasaka & Matsumoto, 2003) came from a cartoon. The *Transformers* (Bonaventura, Bryce, DeSanto, Murphy, & Bay, 2007) movie series and the game were all based on the cartoon series storyline. Contrary to the *Legend of Zelda* (Aonuma & Fujibayashi, 2011), the *Transformers* movie used the story of the game produced by Core Design in 1996.

7.2.2 Principle Rules of Storylining

The stories of many movies, dramas, and games have been derived from the adventures and journeys of the stories' heroes. Vogler and Montez (2007) suggest the 12-stage Hero's Journey model in their book "The Writer's Journey."

Stage 1. Ordinary world
Stage 2. Call to adventure
Stage 3. Refusal of the call
Stage 4. Meeting with the mentor
Stage 5. Crossing the first threshold
Stage 6. Tests, allies, enemies
Stage 7. Approach to the inmost cave
Stage 8. Ordeal
Stage 9. Reward (seizing the sword)
Stage 10. The road back
Stage 11. Resurrection
Stage 12. Return with the elixir

There are many novels, movies, dramas, and games that have used Vogler and Montez's (2007) model. Of course, not all stories include the 12 stages. Some stories have some of the stages in the model or sequence them differently.

Stories in gamification for education and learning are usually simpler than the 12-stage Hero's Journey model. In gamification of education and learning, it is more important to deliver meaningful knowledge than fun itself. That is, the role of the story in this context is to support education and learning, rather than to only create fun and entertainment as in novels, movies, dramas, or games.

7.3 Dynamics

Korhonen, Montola, and Arrasvunori (2009) suggested the Playful Experience framework (PLEX framework) for gamification dynamics. The PLEX framework consists of 20 categories of playful experiences. The following are the categories and the definition of each of them.

- Captivation: Experience of forgetting one's surroundings
- Challenge: Experience of having to develop and exercise skills in a challenging situation
- Competition: Experience of victory-oriented competition against oneself, opponent, or system
- Completion: Experience of completion, finishing, and closure, in relation to an earlier task or tension
- Control: Experience power, mastery, control, or virtuosity
- Discovery: Experience of discovering a new solution, place, or property
- Eroticism: Experience of sexual pleasure or arousal
- Exploration: Experience of exploring or investigating a world, affordance, puzzle, or situation
- Expression: Experience of creating something or expressing oneself in a creative fashion
- Fantasy: Experience of make-believe involving fantastical narratives, worlds, or characters
- Fellowship: Experience of friendship, fellowship, communality, or intimacy
- Nurture: Experience of nurturing, grooming, or caretaking
- Relaxation: Experience of unwinding, relaxation or stress relief, calmness during play
- Sadism: Experience of destruction and exerting power over others
- Sensation: Meaningful sensory experience
- Simulation: Experience of perceiving a representation of everyday life
- Subversion: Experience of breaking social roles, rules, and norms
- Suffering: Experience of frustration, anger, boredom, and disappointment typical to playing
- Sympathy: Experience of sharing emotional feelings
- Thrill: Experience of thrill derived from an actual or perceived danger or risk.

7.4 Mechanics

Schonfeld (2010) suggested a gamification mechanic based on a deck of cards developed for SCVNGR, a mobile gaming platform in which gamers visit places and perform activities to earn points. Table 7.1 shows the card deck for SCVNGR.

Kumar and Herger (2013), Duggan and Shoup (2013), Werbach and Hunter (2012), Zichermann and Linder (2013), and Bunchball (2016) all suggested different perspectives on mechanics. Leaderboard, however, is a common mechanic across the different perspectives. The badge, challenge (or quest), level, point, and virtual item (or good) are other common mechanics. Table 7.2 compares the gamification mechanics from research.

Table 7.3 shows the mechanic elements that are based on studies from Duggan and Shoup (2013), Kapp (2012), Kumar and Herger (2013), Radoff (2011), Schell (2014), and Zichermann and Linder (2013).

Table 7.1 Card Deck for SCVNGR

Achievement	Loyalty
Appointment dynamic	Meta game
Avoidance	Micro leaderboards
Behavioral contrast	Modifiers
Behavioral momentum	Moral hazard of game play
Blissful productivity	Ownership
Cascading information theory	Pride
Chain schedules	Privacy
Communal discovery	Progression dynamic
Companion gaming	Ratio reward schedules
Contingency	Real-time vs. delayed mechanics
Countdown	Reinforcer
Cross-situational leaderboard	Response
Disincentives	Reward schedules
Endless games	Rolling physical goods
Envy	Shell game
Epic meaning	Social fabric of games
Extinction	Status
Fixed interval reward schedules	Urgent optimism
Fixed ratio reward schedule	Variable interval reward schedules
Free lunch	Variable ratio reward schedule
Fun once, fun always	Viral game mechanics
Internal reward schedules	Virtual items
Lottery	

7.4.1 Rewards

- Point: Numerical reward for specific behaviors. Gamers can attain higher levels and receive badges by achieving target points (Experience points). In some cases, gamers can use the points for purchasing virtual goods or physical goods (Redeemable points). Also, gamers can give points to a gamer for his/her good behaviors or contributions (Karma points). The Karma points can facilitate altruism among gamers. Figure 7.6 illustrates a scene of SimCity BuildIt (Electronic Arts Inc., 2013) game, produced by Electronic Arts Inc. In this game, population size is a point. Players can achieve higher levels by increasing the population size.
- Level: Section of a game. Gamers can experience higher levels by completing a specific task. Some games use numbers to present different levels, but others use words. For example, peasants, merchants, farmers, knights, nobles, and monarch can be used for the levels in a game that has the medieval Europe as its setting. There can be a single level system or multiple level systems in a game. For example, physical strength, wisdom, and popularity levels can be simultaneously used for a game. Higher levels usually require gamers to complete more difficult tasks than lower levels do. The rewards are often bigger or

Table 7.2 Comparison of mechanics

Mechanics	S	K&H	D&S	W&H	Z&L	B
Achievement	Y			Y		
Appointment dynamic	Y					
Avatar				Y		
Avoidance	Y					
Badge		Y		Y	Y	
Behavioral contrast	Y					
Behavioral momentum	Y					
Blissful productivity	Y					
Boss fight				Y		
Cascading information theory	Y					
Chain schedules	Y					
Challenge & quest		Y	Y	Y		Y
Collection				Y		
Combat				Y		
Communal discovery	Y					
Companion gaming	Y					
Content unlocking				Y		
Contingency	Y					
Countdown	Y					
Cross-situational leaderboard	Y	Y	Y	Y	Y	Y
Disincentives	Y					
Emotion		Y				
Endless games	Y					
Envy	Y					
Epic meaning	Y					
Extinction	Y					
Feedback			Y			
Fixed interval reward schedules	Y				Y	
Fixed ratio reward schedule	Y				Y	
Free lunch	Y					
Fun once, fun always	Y					
Gifting & charity				Y		Y
Internal reward schedules	Y				Y	
Journey		Y				
Level			Y	Y	Y	Y
Lottery	Y					
Loyalty	Y					
Meta game	Y					
Micro leaderboards	Y	Y	Y	Y	Y	Y
Modifiers	Y					
Moral hazard of game play	Y					
Narrative		Y				

(continued)

Table 7.2 (continued)

Mechanics	S	K&H	D&S	W&H	Z&L	B
Onboarding		Y				
Ownership	Y					
Point		Y	Y	Y	Y	Y
Pride	Y					
Privacy	Y					
Progression dynamic	Y	Y				
Ratio reward schedules	Y				Y	
Real-time vs. delayed mechanics	Y					
Reinforcer	Y					
Relationship		Y				
Response	Y					
Reward schedules	Y				Y	
Rolling physical goods	Y					
Scaffolding		Y				
Shell game	Y					
Social fabric of games	Y					
Social graph				Y		
Status	Y					
Team				Y		
Urgent optimism	Y	Y				
Variable interval reward schedules	Y				Y	
Variable ratio reward schedule	Y				Y	
Viral game mechanics	Y					
Virtual items	Y			Y		Y

Table 7.3 Mechanic elements

Categories	Mechanics
Rewards	Point, level, progression, badge, authority, virtual good, physical good, discontinuation, gifting, free lunch, and virtual currency
Reward schedules	Fixed interval reward schedule, fixed ratio reward schedule, variable interval reward schedule, and variable ratio reward schedule
Avoidance	Discouragement and leaky bucket
Leaderboard	Macro leaderboard, micro leaderboard, indirect competition, and direct competition
Status	Avatar and social network
Quest	Unlocking content, countdown, lottery, communal discovery, and scaffolding

better at higher levels. However, the rate of increase in rewards is slower than the rate of increase in requirements necessary to advance to the next level. Thus, even though the game may progress at a slower pace, gamers feel that they receive more and better rewards. In Fig. 7.6, the number 44 on the top left side is the level.

Fig. 7.6 Population size as a point in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

- Progression: Means to show the degree of advancement in a game or sometimes within a level. Numbers, bar charts, line charts, pie charts, or images can be used for showing the progression. Some games mix these media. For example, a combination of a number and a pie chart can be used together to show a player's progress. SimCity BuildIt (Electronic Arts Inc., 2013) uses an image consisted of a number and a pie chart (see Fig. 7.6).
- Badge: Most visible achievement note. Badges can show other gamers the skills or accomplishment of a gamer. Gamers can win badges for completing necessary tasks. Some games use the badge as the level system and some others use the badge as a different mechanic. However, the badge usually does not have a fixed order and multiple badges are simultaneously used in a game. Because a badge is the mark showing the gamer who accomplished the same task, gamers can have a group identification by the badge (Antin & Churchill, 2011). Gamers collaborate more with other gamers in a group based on the group identification (Dawes, Van De Kragt, & Orbell, 1988). Figure 7.7 describes platinum keys in SimCity BuildIt (Electronic Arts Inc., 2013) game. In the game, a player can receive a platinum key when the player wins the Contest of Mayors. As a badge, the platinum key shows the player's achievement (see Fig. 7.7).

Fig. 7.7 Platinum keys as a badge in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

- Authority: Capacity or ability to control game elements and gamers. When a gamer achieves a specific level, the gamer can be authorized to control characters, shops, villages, or other gamers. The authority can be limited by the specific time period, the number of times used, or the associated event. Some games give gamers unlimited authority. Figures 7.8 and 7.9 illustrate NeoBank and OMEGA storage in SimCity BuildIt (Electronic Arts Inc., 2013) game. Not all players can have these buildings. Only those who achieve a specific level can build and use these buildings.
- Virtual Goods: Goods that can be attained, purchased, or traded within a game. Most representative virtual goods are clothes, accessories, and weapons. Gamers can increase the game speed, make the game character stronger, and unlock special content by the virtual goods. Figure 7.10 shows factories and shops that produce virtual goods, such as wood, steel, hammers, or donuts. Players can sell or purchase the virtual goods through a trade depot. Some games allow a player to decide the price of each good. Through such experience, the player can understand the market, pricing strategy, and customer behaviors. Figure 7.11 illustrates a trade depot in which players sell or purchase virtual goods.
- Physical Goods: Goods that have value in a real world. Gamers can attain the physical goods by an achievement in the game or the use of virtual goods. Some games give gamers real money based on the gamer's achievement. Some people may not believe that there is a game item that can be sold at about $45,000. Lineage is a massively multiplayer online role-playing game. The players in this game need better weapons to achieve higher goals. They can make the weapon

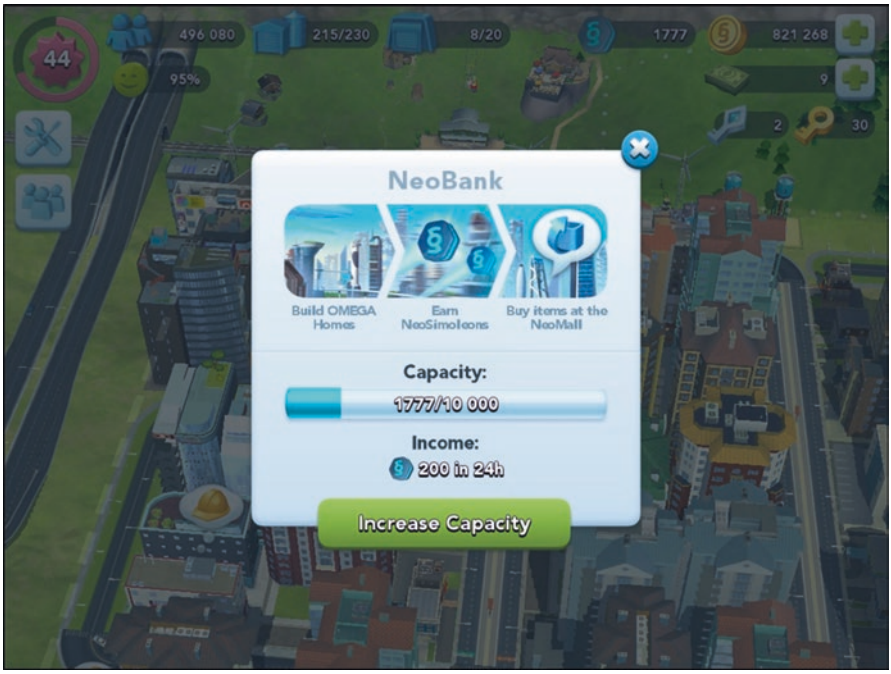

Fig. 7.8 NeoBank in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.9 OMEGA storage in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.10 Producing virtual goods in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.11 Trading virtual goods in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

within the game, but some of them want to have the weapon without investing much time. Because of this reason, they pay real money to buy virtual goods from other players.

- Discontinuation: Device to limit the reward according to a specific behavior. Some gamers repeat a behavior for attaining more rewards. Discontinuation can prevent this kind of behavior.
- Gifting: Giving other gamers the items. Gamers can buy a gift for another player with Karma points. Also, gamers can give other gamers their items. Gifting can be more frequently observed in games that require an active team play to achieve higher goals.
- Free Lunch: Reward without own effort. Gamers sometimes can receive a reward regardless of achievements. The volume and quality of the free lunch can vary depending on the player's progress. Some free lunches disappear after a specific period of time. This mechanism encourages players to visit the game regularly. Some games use this mechanism to advertise their virtual goods to create revenue. Figure 7.12 shows a gift box as a free lunch in SimCity BuidIt (Electronic Arts Inc., 2013). The player in the game sometimes, not always, can see the gift box in the player's city or other players' cities.
- Virtual Currency: Currency that has value only within a game. Gamers can use the virtual currency for purchasing or selling items. Gamers can attain virtual currency by achievement in a game or paying with real money. Figures 7.13 and 7.14 illustrate two kinds of virtual currencies in SimCity BuildIt (Electronic Arts Inc.,

Fig. 7.12 A gift box as a free lunch in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.13 Simoleons in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.14 SimCash in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

2013). Simoleons in Fig. 7.13 is the main virtual currency that can be earned by making the city larger and the citizens happy. The player in the game can use Simoleons to build or upgrade buildings, develop land, and purchase necessary virtual goods. Meanwhile, SimCash in Fig. 7.14 is a more valuable virtual currency. It is hard to earn and can be used for significantly improving the speed of game progress. As a result, some players who want to upgrade their cities as soon as possible pay money for SimCash. Like SimCity BuildIt (Electronic Arts Inc., 2013), some games use multiple virtual currencies to create more revenue, as well as engage more players.

7.4.2 Reward Schedules: Algorithms for Rewards

- Fixed Interval Reward Schedule: Rewards are provided to a player on a specific time schedule. For example, the stamina of a game character increases by 1 stamina point every 3 min.
- Fixed Ratio Reward Schedule: Rewards are provided when a gamer completes a defined number of missions. For example, the stamina of a game character increase 3 stamina points after consuming an energy beverage.
- Variable Interval Reward Schedule: Rewards are provided at irregular time intervals. Unlike fixed interval reward schedules, gamers can receive a reward at various time intervals.
- Variable Ratio Reward Schedule: Rewards are provided when a gamer completes a mission, but the number or difficulty of missions is different each time. For example, a gamer needs to catch ten monsters to receive the reward; then later, the gamer needs to catch 20 monsters instead.

7.4.3 Avoidance: Behavior to Avoid Penalties

- Discouragement: A penalty given when a gamer does not avoid a specific behavior. Discouragement is for preventing gamers from demonstrating a specific behavior. It is the opposite of the reward concept.
- Leaky Bucket: Limitation given over time. Gamers can perform a quest without any limitation at the beginning of the game, but they face limitation over time (Duggan & Shoup, 2013). The limitation can be implemented by the maximum number of available quests or the duration of a quest. For example, in the quest of filling up a leaky bucket, let's assume that gamers can fill up the bucket by pouring water in it ten times. However, 10% of the water inside the bucket disappears every 12 min. As a result, gamers can fill up the leaky bucket once every 12 min after they fill up the bucket. The leaky bucket mechanics can be found in the Hay Day (Supercell, 2012), a mobile farming game. Gamers can experience the leaky bucket when they bake bread. Gamers may use virtual goods to reduce the time for baking.

7.4.4 *Leaderboard: A Board Showing Leading Gamers' Achievements.*

- Macro Leaderboard: A board showing the names, rankings, and scores of the gamers leading the overall game. During the game, the macro leaderboard shows the interim score or ranking of the gamers. When the game ends, it shows the final score or ranking of the gamers. The macro leaderboard in Hay Day (Supercell, 2012) shows the rankings, names, and scores of the gamers loading goods on a freight vessel.
- Micro Leaderboard: A board showing the names, rankings, and scores of the gamers leading the game within a region or a level. The structure of the micro leaderboard is similar to the macro leaderboard. The micro leaderboard encourages beginner or intermediate gamers to compete with others for reward since they compete only with the gamers limited by a region or level. They do not need to worry about competitors that are too strong to compete against. Figure 7.15 illustrates a micro leaderboard in SimCity BuildIt (Electronic Arts Inc., 2013). Depending on the game progress, a player belongs to a league and competes with other players who are in the same league.
- Indirect Competition: Competition based on relative progression of the game. Gamers do not need to compete with other gamers in the indirect competition. That is, one gamer's progression or achievement does not affect other gamers'

Fig. 7.15 A micro leaderboard in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

rankings. This type of competition is appropriate for the networker and the friend types. Figure 7.16 shows an indirect competition in SimCity BuildIt (Electronic Arts Inc., 2013). In Figure 7.16, the player needs to complete three tasks to develop a beach area. The successful completion of the tasks influences only that player's progress.

- Direct Competition: Competition between players. If a player achieves more than other players do, the player's ranking goes up and the other players' rankings go down. Figure 7.17 shows a direct competition in SimCity BuildIt (Electronic Arts Inc., 2013). A player has to compete with other players to win the Contest of Mayors.

7.4.5 Status: Avatar, Ranking, or Social Relationship Within a Game

- Avatar: An avatar visually describes the gamer. A player can use an abstract image as well as a picture of the player. An avatar sometimes embeds its ability or characteristic. With an avatar, as a result, other players can see a player's ability or characteristic without looking into the player's profile. Some games sell accessories that can be used for adorning the avatar. Since some accessories improve the ability of avatars, some players purchase them.

Fig. 7.16 An indirect competition in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

Fig. 7.17 A direct competition in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

- Ranking: Ranking is a result of competition with other players. While points and levels can be affected by a player's achievements, ranking can be also influenced by other players' achievements. As with the two types of leaderboards, ranking can be also determined by overall achievements within a whole game or an achievement category. Ranking is a criterion for rewards as well as a result of a player's achievements. High rankers are usually more interested in their rankings than low rankers are.
- Social Network: Social networks show the status of other gamers. The gamer can see the names, avatars, and progression of the other gamers. The gamer can click "Recommend" or "Like" button to share his/her feelings or thoughts. In SimCity BuildIt (Electronic Arts Inc., 2013), gamers can be connected through social network services like Facebook.

7.4.6 Quest: Specific Mission to Complete to Receive Rewards

- Unlocking Content: Gamers cannot experience the locked content unless they complete a specific quest or reach a required level or point. If gamers meet the requirement to unlock the content, they can see the items, scenes, characters, functions, or missions that they could not see before unlocking the content.

- Countdown: Given time to complete a specific quest. Gamers need to complete a specific quest or perform a behavior within the given time.
- Lottery: Reward type with haphazardness. Gamers can attain this type of reward by accident or for an unintended behavior.
- Communal Discovery: Quest completed by gamers' collaboration. A single gamer cannot complete this kind of mission. Communal discovery must be completed by gamers' collaboration.
- Scaffolding: Support for the gamers who need help to perform a quest. Scaffolding can be implemented by help message, agent/hasher, shared strategy, and so on. Figure 7.18 illustrates FAQ for the Contest of Mayors in SimCity BuildIt (Electronic Arts Inc., 2013). This FAQ is used as scaffolding for those who need help to participate in the contest.

7.5 Technology

Gamification for learning and education needs various technologies for implementation. Gamification can be implemented by not only information technologies, but also things in our real life such as paper, wooden sticks, badges, stickers, cards, or different types of toys. Though this book focuses on information technologies, the readers do not need to limit the range of technologies for gamification.

Fig. 7.18 FAQ as scaffolding in SimCity BuildIt (Reproduced from SimCity BuildIt, Copyright 2013 by Electronic Arts Inc.)

The technology in this book will be explained by two large categories: hardware and software.

7.5.1 Hardware

7.5.1.1 Wearable Devices

Many gamified learning and education users have used computers, tablets, and smartphones as a user device. With those devices, learners can participate in apps, websites, or social network services that employ gamification. These devices will serve the needs of gamification until existing technology enters a saturation phase and newer technology is developed to replace them.

Look back on the feature phone market in 2005 and 2006. The feature phone market was at the saturation state and a revolutionary device, iPhone, appeared in 2007. Technology S-Curve (Christensen, 1992; Foster, 1986; Scillitoe, 2013) explains the patterns observed in this situation. That is, a new product or service tends to come to the market when an existing product or service is at the saturation phase. Many market reports have shown the smartphone market is already at the saturation phase. This means a new product that can replace the smartphone will appear.

Most possible substitute goods are wearable devices, suggested by MIT (Massachusetts Institute of Technology) in 1966, meaning devices or computers that are worn on clothing or a part of human body. With a wearable device, a person can interact with the device by gaze, voice, or gesture. Some industries like clothing, textile, glasses, auto, and shipbuilding have been using wearable devices. The application of the wearable device can influence gamification in learning and education. In this section, some wearable devices will be reviewed to note their characteristics and potential utilization for gamification in learning and education.

Google Glass Google developed Google Glass which can be controlled by voice and a touchpad. The transparent glass of this device is used for displaying information. Although the glass is small, the user does not recognize its true size. Instead, the user experiences the feeling that it is a 25-inch monitor that is about 95 inches away. Though some issues exist such as price, privacy, and usability, Google Glass still has potential uses in gamification.

Jawbone's UP Jawbone has developed a series of wearable devices for healthcare, named UP. People can see the information on their sleep, activity, calories burned, and heart health by connecting UP to a smartphone. UP tracks the behavioral patterns of the user and provides advice to improve the user's health. These features of UP can be applied for physical training, medicine, or other industries, especially some tasks asking appropriate physical conditions of workers.

Sight Systems In 2012, Eran May-raz and Daniel Lazo shared a video on YouTube (May-raz & Daniel, 2012). The video was created to meet the graduation requirement of Bezalel Academy of Arts in Israel. They named the video Sight Systems and tried to show their audience a future in which people used wearable devices in their daily lives. Figure 7.19 is a screenshot of Sight Systems. The person in the video is performing a superman exercise. He is using a wearable device similar to contact lenses (see Fig. 7.20).

Using the wearable device, he can experience a virtual experience. Figure 7.21 shows what he can see during the superman exercise.

With the wearable device imagined in *Sight Systems*, people can experience gamified cooking. While they are cooking, they are asked to complete missions to achieve higher scores. The missions play a role of scaffolding or direct instruction for successful cooking. In Fig. 7.22, for example, there are dashed lines on a vegetable to show where the person should cut (May-raz & Lazo, 2012).

Figure 7.23 illustrates a scene that a player can see during gameplay. The left side of the screen shows a mission that the player has to complete to achieve a goal. If the wearable device recognizes that the player successfully completes this stage of the mission (tilting the pan to move the egg), the player can move forward to the next stage (May-raz & Lazo, 2012).

The wearable device in *Sight Systems* can be used for dating. While dating, the user is asked to complete certain quests that can make the dating successful. If the user completes the quests, the level of favorability represented in the score is increased (May-raz & Lazo, 2012) (see Fig. 7.24).

Fig. 7.19 Superman exercise using a wearable device (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

Fig. 7.20 A player's eyes with wearable devices (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

Fig. 7.21 A scene from the game for superman exercise (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

7.5.1.2 Augmented Reality

Augmented reality is a technology that makes the real-world environment more valuable or easy to use by adding meaningful information created by information technologies. For example, augmented reality can add navigation information for someone who is walking or driving on a new road (see Fig. 7.25).

Fig. 7.22 Gamified cooking using a wearable device (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

Fig. 7.23 A mission in gamified cooking (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

Another good example of the application of augmented reality is fixing vehicles at home. The user of Google Glass follows step-by-step instructions for diagnosing and fixing problems. Google Glass not only provides the instruction, but also detects if the user actually follows the instruction. From the visual information collected by the camera in Glass, it can decide if the user correctly followed the instruction.

Fig. 7.24 Dating using a wearable device (Reproduced from "Sight," by Robot Genius, 2012, retrieved from www.robotgeniusfilms.com Copyright 2012 by Robot Genius)

Fig. 7.25 Navigation information provided by Google Glass (Reproduced from Google Glass Youtube Channel, by Google, 2013, retrieved from https://www.youtube.com Copyright 2013 by Google)

7.5.2 Software

It is difficult to implement gamification for learning and education only with hardware technologies. Most hardware does not work without accompanying software. Radoff (2011) includes graphic design and programming in the technologies necessary for developing social games, which are hosted on social network services. However, this section focuses on the gamification platform and development tools rather than programming languages or graphic software.

7.5.2.1 Gamification Platform

A gamification platform tracks, measures, and logs gamers' behaviors within gamified learning and education. It gives gamers feedback and rewards based on their behaviors. For the developers and administrators, it provides the analysis tool and the programming library connected to legacy systems.

It is not always necessary to employ a gamification platform for developing gamified apps and websites. However, with the gamification platform, the development can be more convenient and efficient since the platform provides common development resources (Zhu, Pei, & Shang, 2017). Especially when developing large-scale gamification programs, the use of a gamification platform can reduce the development time, cost, and the risks associated with the major requirement change.

Herzig, Ameling, and Schill (2012) suggest a generic platform for enterprise gamification, which includes analytics, game data, business rule management system (BRMS), and game rules and mechanics. The platform can collect and analyze the data on users' behaviors with game data and analytics components. Also, designers and developers can control the gamification programs in the platform by manipulating the BRMS and game rules and mechanics.

The generic gamification platform is not integrated with legacy systems. As a result, it is more flexible than an integrated gamification solution since it does not need to meet the rules of the legacy systems, and it communicates with the legacy system through application program interface (API) which is a set of definitions of routine and subroutines, protocols, and libraries (Herzig, et al., 2012).

The generic gamification platform is more scalable than an integrated gamification solution since it supports multiple systems inside or outside organizations. A downside caused by its scalability is that it can be hard to ensure required performance levels in some situations. Thus, it may be an effective strategy to estimate possible performance before expanding the platform coverage (Herzig, et al., 2012).

Figure 7.26 illustrates an enterprise gamification platform that is based on the generic gamification platform suggested by Herzig et al. (2012). Unlike the generic platform, in the enterprise platform the communication channel is separated into two separate channels: internal and external channels. Because of security issues and system performance, most corporations separate the communication channel. The enterprise gamification platform in Fig. 7.26 reflects this practical practice. Users send and receive data to and from the gamification platform via an external communication channel. In addition, an internal communication channel is used for the interaction between the gamification platform and the legacy systems or the gamification administrator.

Herger (2011) suggests a checklist for evaluating gamification platforms, which consists of nine categories: game mechanics, functionality, programmability, security, administration, platform architecture, nonfunctional requirements, business model, and company profile. Table 7.4 shows the criteria in each category.

Kim (2014) suggests a decision-making framework for selecting a gamification platform. Table 7.5 illustrates the criteria for each category and subcategory.

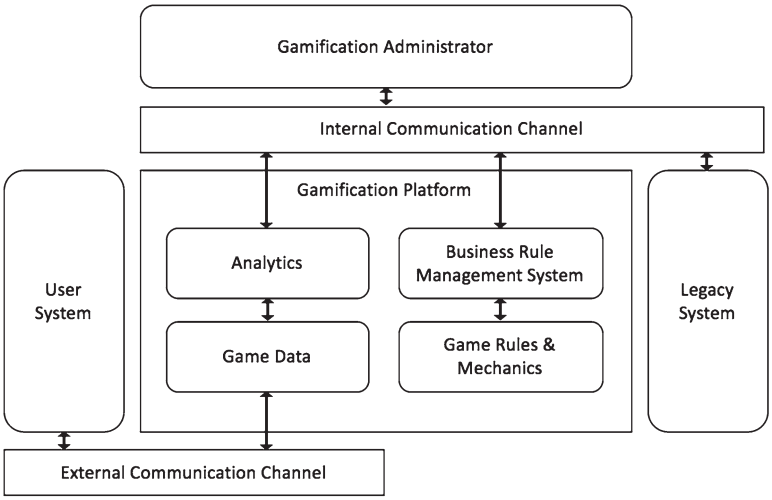

Fig. 7.26 An enterprise gamification platform based on generic gamification platform suggested by Herzig et al. (2012)

Table 7.4 Checklist for evaluating gamification platforms

Category	Criteria
Game mechanics	Rank/levels/achievements, currencies, measures, feedback, individual avatar, communication system, 3D environment, marketplace, economy, teams, time pressure, competition, difficulty adaption, learning path, fun failure, social connectivity, meaning/purpose
Functionality	Default currencies, default achievements/badges, distinction between currencies & measures, currency transactions, customizability of currencies/levels/badges/goods, customizability of goals/rules, repository for mechanics/missions/artifacts, goals & rules engine, transaction engine, data push, data location, integration with ERP system
Programmability	API access, API libraries, complexity, extension concept
Security	Confidentiality, integrity, availability, access control, data authenticity, player authenticity, single sign on
Administration	Analytics, separator of duties, administrator levels
Platform architecture	Infrastructure, databases, operating systems, scalability, delivery model, security, interoperability, backup/high availability
Nonfunctional requirements	Accessibility, documentation, localization, maintainability, open source, integration, response time, community
Business model	Licensing
Company profile	Development/support team structure, reference customers, roadmap/strategy

Bunchball is one of the gamification platform and solution vendors. Nitro (Bunchball, 2007) is a gamification platform that supports user engagement, loyalty management, sales promotion, customer retention, customer behavior change, employee motivation, and employee training (Hate, 2013).

Table 7.5 Decision criteria for selecting gamification platform

Category	Subcategory	Criteria
Credibility of supplier	Business record	Market share, sales history, and partnership
	Expertise	Number of gamification professionals, success story
Product competitiveness	Terms of sale	Price, marketing program
	Product architecture	Hardware requirements, supported operating systems, development languages, supported databases
	Features	Supported gamification mechanics, connectivity to external game engines, security, analytics
	Performance	Functionality, reliability, usability, efficiency, maintainability, portability
Service continuity	Stability of supplier	Financial stability, vision, and experience of executives
	Terms of contract	Terms of warranty, terms of product liability

There are many gamification platform and solution vendors including Badgeville, Behave.io, Beintoo, Bemore, BizPart Engage, Bunchball, Busification, CellCast Solution, CRMGamified, Echo.it, EMee, Freshdesk Arcade, Funifier, Gameboxed, GamEffective, Gametize, Gaminside, Gimmie, H Engage, Hoopla, Hooptap, Hopskoch, Influitive, Keas, LevelsPro, Pactify, ParWinr, PropsToYou, RedCritter Connecter, SAP Enterprise Gamification Platform, ShapeUp, Wheeldo, Wonnova, and Zurmo.

7.6 Tools for Developing Games and Augmented Reality

- Unity: Unity (Unity Technologies, 2004) is a game engine for developing 2D or 3D games. It supports multiple operating systems such as Windows, Mac OS X, Android, and iOS. It can also be used for developing games for video games like X-Box and PlayStation. The programming languages that Unity (Unity Technologies, 2004) supports are C#, Boo, and JavaScript. With this particular game engine, developers do not need to write codes for common functions supported by the engine. As a result, the speed of game development can be increased and the quality of outcomes can be assured. This can reduce developers' workloads related to graphic rendering, physical engine, network, geography, audio, video, and animation.
- GameMaker: GameMaker (Overmars, 1999) is a tool for people, with or without programming skills, to develop games. It uses graphic user interface and game developers can drag-and-drop instead of writing codes. It is a cross-platform tool and supports Windows, Mac OS X, Android, iOS, and PlayStation. Although GameMaker can be a useful tool for developing games because of its intuitive user interface, it is also limited to developing noncomplicated games.
- ARToolKit: ARToolKit (Kato, 1999) is an open-source programming library for developing applications using augmented reality. With ARToolKit using computer vision techniques, developers can easily overlay virtual objects.

ARToolKit supports smart glasses, GPS, compass, optical stereo calibration, and camera position and orientation tracking.

- FreshAir: FreshAir (Mogo Mobile Inc., 2014) is a development tool for implementing augmented reality based on geographic information. People can use the FreshAir Editor, which is a web-based editor, for developing augmented reality applications without any programming codes. FreshAir can be used for developing games, university tour, city guide, educational programs (Dunleavy, 2014).

The elements for gamification in learning and education are story, dynamics, mechanics, and technology. However, this does not mean that all of the four elements must be used for gamification in learning and education. Also, using many gamification elements does not ensure more effective gamification or better results (Mora, Riera, González, & Arnedo-Moreno, 2017). Considering the given conditions, educators should choose necessary gamification elements and make them as an integrated solution, no matter how large, to solve problems in learning and education.

Let's trace back our memory to when we were young children. Most of us were pleased with a "Great Job!" stamp that a teacher gave us. It encouraged us to deliver a better performance. Using the stamp, or a course with fair and clear reward rules, is a form of gamification. The quality of gamification in learning and education is not determined by the size of the gamification.

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