Designing awareness games for solving complex problems

Towards a more comprehensive design framework

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Summary

Duke (1974) put games on the map as a tool for solving complex problems, due to their ability to communicate gestalt or holistic thought. With the increasing complexity of problems, games are also becoming more relevant as a tool for solving those problems. In this thesis, we focused specifically on games for generating awareness, which is an important first step in solving complex problems. We found that existing game design frameworks are incomplete and lacking practical guidance for designing awareness games. Our research objective was to address this and work towards a more comprehensive framework for the design of awareness games, leading to the following research question:

> *How can we integrate existing game design frameworks into a more comprehensive game design framework for awareness games?*

We have looked to answer this question by using the Design Science Research methodology, which essentially focusses on increasing knowledge and understanding through the act of building. The methodology consists of four main activities: problem diagnosis, design, evaluation and theory building.

For the problem diagnosis, we compared existing game design frameworks to issues that awareness game designers experience during game design. We found that the existing game design frameworks are inadequate at dealing with them.

We then looked to design a framework that is better equipped to deal with them, utilizing the knowledge base we have from the existing game design frameworks. We have looked at academic sources as well as the entertainment game design literature. For the design of this framework, we looked at the roles that the existing game design frameworks could play for awareness games. From the academic sources we distilled a 3-level structure to form the core of the design framework:

- The contextual (high) level, containing frameworks looking at the input, context and output of the game design process. They help determine the criteria for the steps in the design process.
- The procedural (medium) level, containing the structure of the design process, with the various design stages and steps.
- The developmental (low) level, containing more concrete details on how to develop the deliverables in each of the design steps.

We extracted core concepts from the entertainment game design literature to provide more concrete guidance for the design process.

We then evaluated the framework by interviewing game design experts and analyzing a game design case using the framework. This led to further adjustments of the framework based on the feedback.

In terms of final theory building, the end result is a design framework, that integrates existing design frameworks based on that 3-level structure, that provides an overview of the game design process. We find that it has potential relevance during the design process for planning, communication, monitoring, documentation, balancing, idea generation, checking, evaluation and analysis. We also believe that it can be a first step in looking to optimize the design process.

Further research is still required to further complement the framework and test it in practical setting.

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Chapter 1: Introduction

"*A game can provide an overview or gestalt perspective, a level of detail appropriate to the task at hand, and mechanisms which illustrate the major dynamics of the linkages among the system components. Gaming has particular potential because it permits the individual to approach complex problems from whatever perspective seems germane and to do so in a context which is coherent and logical, and to experiment in an environment which is basically safe."* – Duke, R.D. (1974)

1.1. Games for solving complex problems

In his well-known 1974 work, Duke laid the groundwork for using games to tackle complex problems. He identified an urgent need to tackle such problems, as exponential advances in technology and knowledge lead to problems becoming ever more complex. In order to deal with such problems, Duke (1974) argued that it is crucial to comprehend the whole system at hand and be able to communicate holistic thought, or the gestalt. He goes on that traditional languages are poorly equipped to communicate gestalt. They require translating holistic image into a sequential string of component descriptions, which then have to be reconstructed by the listener into that image. With the increasing complexity of problems this becomes ever more difficult to do. Games on the other hand can provide this gestalt perspective, which is why Duke (1974) aptly named gaming as the "future's language". In his later work with Jac Geurts, more concrete illustrations are provided on how games can aid in resolving complex problems based on the 30 years of practical and academic work that had followed (Duke & Geurts, 2004). In it, Duke & Geurts (2004) have identified "five Cs" that are important to resolving complex problems:

1. Complexity, appropriately taking into consideration the complex aspects of the problem;
2. Communication, often multiple decision makers have to communicate or the decision relies on information held by many different people;
3. Creativity, in many cases problems can be approached using new combinations of proven lines of actions, but this requires creativity in recognizing analogies between the new problem and familiar situations;
4. Consensus, new challenges can bring out conflicts of values, that require consensus to be rebuilt;
5. Commitment to action, strategies require many individuals to act, which presupposes that the problem is understood, they see the relevance of the strategy and their role in it, and feel confident in their skills to overcome the obstacles.

An important first step in solving such complex problems is the generation of awareness. Awareness games can address those five Cs, for instance by:

- Making players aware of the complex elements of the problem;
- Helping with communication through providing gestalt overview;
- Inspiring creativity and innovation during play;
- Generating consensus by allowing players to explore consequences from different perspectives;
- Facilitating commitment to action by putting it all together to help formulate a strategy.

The focus of this thesis is on the development of an improved methodology for designing such awareness games.

Relevance of awareness games

Before going in-depth on why we need an improved methodology, we discuss why awareness games are relevant in the first place. In today's world, organisations face many different complex problems, that are often multi-disciplinary in nature with multiple parties involved. With all those perspectives in play, the importance of aligning perspectives, and with it the need for gestalt understanding increases. Take for instance:

- Policy decision making when multiple stakeholders are involved with different interests;
- Determining company strategy;
- Fostering a shared company culture;
- Cost-benefit analysis with multiple parties valuing the various solutions differently;
- Figuring out how to protect innovations when multiple parties are working together;

Awareness games may also be applicable to more publically related topics such as:

- Combatting food waste amongst consumers;
- Promoting sustainability regarding household energy usage;
- Health-related topics such as obesity;

Looking at a selection of current practices of awareness games we several practical examples of applicability for businesses such as: reducing waste within supply chain management (Hauge et al., 2014), improving cyber security (Denning et al., 2013), marketing of complex technologies (Kiong et al., 2016) or improving multi-disciplinary cooperation (Douven et al., 2014). A more detailed analysis of these and other practical examples can be found in Appendix B.

Defining awareness games

Now that we have discussed the relevance of awareness games, what exactly are they? We have not found specific definitions for awareness games in the literature. Additionally, the concept of awareness has a broad spectrum of different definitions in the literature, depending on the context in which it is used, for example, Situation Awareness (Endsley, 1995), Context Awareness (Schilit et al., 1994) or Activity Awareness (Brewer & Dourish, 2008). Teruel (2016) provides an extensive list of various awareness definitions available in literature in different contexts. We thus chose to develop our own definition for awareness games that aims to fit the context of games as a first step for solving complex problems. Firstly, we looked at the gestalt perspective that is crucial for solving complex problems (Duke, 1974) as we mentioned earlier. One way to describe systems, that is also in the context of games, is provided by Salen & Zimmerman (2004). They describe that systems consist of the following elements:

1. Objects - the parts, elements, or variables within the system. These may be physical or abstract or both, depending on the nature of the system.
2. Attributes - the qualities or properties of the system and its objects
3. Relationships – the internal relationships among objects
4. Environment – systems do not exist in a vacuum but are affected by their surroundings

Secondly, we looked at how the term awareness games is used in current practices for awareness games. We found those awareness games to have either implicit or explicit goals that can be related to Bloom's

(1956) Taxonomy of learning domains as we show in Table 1. A more detailed analysis can be found in Appendix B.

Table 1 Awareness game goals in current practices related to three layers of Bloom's (1956) taxonomy of learning domains

Awareness game goals	Bloom's (1956) Taxonomy of learning domains
Convey breadth of topic Learn about topic	Knowledge
Increase understanding	Comprehension
Apply framework/approaches Apply knowledge Select tools	Application

Inspired by Bloom's (1956) hierarchical structure of learning domains and the three-level structure of Situation Awareness by Endsley (1995), we choose a similar structure to define awareness at three different levels and combine it with the system perspective we described earlier. At each level, a person can be said to:

Level 1 (Knowledge): have knowledge about a system's objects and attributes.

Level 2 (Comprehension): comprehend the interrelationship between level 1 elements and the environment it exists in.

Level 3 (Application): have the ability to make a projection of the output of the system for a certain input.

With this definition of awareness, we tried to relate how the term awareness game is used in practice to Duke's (1974) point of understanding the gestalt. The breakdown into three levels allows for a distinction of intermediate steps, as we also see in current practices of awareness games. Furthermore, it sets up for potential measurement of awareness at three different levels.

Difficulties in designing awareness games

We return to the discussion of why an improved methodology for designing awareness games is in fact necessary. The design and development of an awareness game is not at all a straightforward feat. We can illustrate this with a number of difficulties that designers may encounter during the design of awareness games:

- Hauge et al. (2014) mention the difficulty of translating field-specific knowledge into the game and use it to better develop games that mirror the complexity of decision making in reality.
- They also mention that it is difficult to strike a balance between the complexity of the real world problem and the learning objective. If the complexity in the game is too high, it may hinder learning outcome. If the game is abstracted too far from the complex reality, the learning outcome might not be as useful.
- De Jans et al. (2017) highlight the difficulties that awareness games often involve many different stakeholders, whose perspectives all should be heard. Incorporating them into a game is not at all easy. Schell (2008) also add to the importance of the perspectives of the client, the target group as well as the design team.

- Dionnet et al. (2007) found difficulties in choosing the correct degree of abstraction for developing their game. As with the complexity, a balance has to be struck between enough abstraction to get out of usual scheme to consider different viewpoints, but not too much to maintain a relation to the real problem case.
- Depigny & Michelin (2007) struggled with determining the appropriate format of the game, specifically whether to develop a digital or an analog game.
- From interviewing other game design experts, which we feature in Chapter 4, we find that other determining game elements such as indicators/scoring and micro/macro cycles outside of the game artifact itself (e.g. reflection moments and breaks) are also non-trivial.

Game design methodologies for awareness games

Is a methodology necessary, however? At one extreme, one might view designing a well-constructed game as the work of a master artist (Peters & Van de Westelaken, 2014). It is the neat balancing of all different components to consider, in order to create what can be thought of as a magical experience for the player. Understanding the process of how that game came to be is irrelevant. It is part of the skill and experience of the master artist. Then there is the other extreme at which game design is viewed as craftsmanship, based on a systematic, transparent and repeatable process. In practice, each designer has their own style and operates somewhere along this continuum.

As Fullerton (2008) mentions, designing a good game is a challenging task, that requires a playful approach but a systematic solution. In light of this, we believe that a well-developed design methodology provides a lot of merits, especially concerning awareness games. Peters & Van de Westelaken (2014) neatly sum up the advantages of a design methodology:

- They enhance structured, systematic working and thus increase transparency
- Often multiple people are involved in the design and development of games. A design methodology allows for better communication and collaboration amongst all parties.
- In case the product does not meet the set target, the design process can be analyzed in hindsight for improvement or redesign.
- A systematic methodology offers more opportunities to guarantee correspondence to the real-life situation and make checks to improve validity.
- Facilitators that guide the simulation of the game will need to be aware of the ins and outs of the game. In case they have not been part of the design team, the facilitators need to be informed of the dynamics of the game and the choices that were made. A systematic and transparent design process allows for that transfer of information to facilitators.

Preliminary findings indicate however, that existing game design methodologies, such as those developed by Duke & Geurts (2004), Harteveld (2011) and Hunicke et al. (2004), are inadequate at dealing with all the aforementioned difficulties of designing awareness games. Carvalho et al. (2015) highlight that design methodologies focus mostly on high-level aspects, but it is unclear how to concretely satisfy those requirements. We can attest to that from our own experience with for example Harteveld's (2011) work on triadic game design. There he describes the difficulties Hauge et al. (2014) experience regarding the balance between real-world case and learning objective and the importance of taking into account different perspectives. However, it does not address how to do so in a practical sense.

Another point that further highlights the inadequacy of the game design methodologies for awareness games is that we find that design methodologies are hardly being used in current practices. In fact, the design process is in most of those cases self-developed. A more detailed review of those current practices can be found in Appendix B. These indications prompted us to look further into the literature on designing awareness games.

1.2. Current state of literature for designing awareness games

In this section we sketch the current state of the literature on designing awareness games. This allows us to generate an overview of what has been done and reflect on what issues it does not yet resolve.

1.2.1. Game design from a process perspective

Duke & Geurts (2004) present much of the groundwork for a process based methodology for developing awareness games. They discuss a design sequence consisting of five phases: (1) setting the stage for the project, (2) clarifying the problem, (3) designing the policy exercise, (4) developing the exercise and (5) implementation for proper use by the client. These phases are then further elaborated into 21 steps that are explained in more detail. While the schematic they present seems like a waterfall model, they highlight that the process as a whole has an iterative nature. For instance, the fourth phase of developing the exercise generally requires ten test run iterations.

Duke & Geurts (2004) felt that it is important for the advancement of the field that communication about games, within the field of gaming itself, but also towards the clients are improved. From their practice, the client subject matter is extremely diverse, resulting in products that have rather dissimilar characteristics. A consequence of this is that their design sequence is generically applicable as a process, but does not include a lot of content for designing the game artifact. In order to improve communication and analysis of the games, they advocated for specific nuclei for the field of gaming to be developed.

1.2.2. Game-specific nuclei

Several authors then developed models for deconstructing games into game-specific nuclei. Those models aid in analysis and communication in the game design process. One of the more frequently cited ones is the MDA (Mechanics, Dynamics and Aesthetics) framework by Hunicke et al. (2004). The framework deconstructs games into its Mechanics, Dynamics and Aesthetics. The breakdown uses the perspective of how the components of the game interact with the player. Amory's (2007) game object model version II takes a slightly different approach and looks more at the different components of the games and how they interact internally with each other. Westera et al. (2008) provides another different take by distinguishing different levels in the development of games, the conceptual, technical and practical level.

1.2.3. A triadic perspective on game design

Following these frameworks of deconstructing games, several authors propose that a more multi-disciplinary perspective is required in the development of games, aside from the analysis of games as an artifact. In his work on Triadic Game Design, Harteveld (2011) describes a need for balancing three "worlds" during the design of games, Reality, Meaning and Play. Each of these worlds interact with different people, criteria and disciplines. Games are generally associated with "Play", but a balance needs to be struck between for instance the "fun" element, the realism of the game abstraction and how that translates into achieving the objective of playing the game. Rooney (2012), Winn (2009) and Frank (2007) provide similar insights, advocating for the importance of a triad of different elements during game design, albeit with slightly different terminology and focus. Rooney's (2012) framework is very similar to

Harteveld's (2011) except that it focusses more on the development of educational games and identifies a triad of play, pedagogy and fidelity. Winn's (2009) DPE framework (Design, Play and Experience) is an expansion of Hunicke's (2004) MDA framework. He discusses that the MDA framework can be approached from an academic, content-expert or game designer perspective and that the heart of game design lies in the overlap of those perspectives. Frank's (2007) work discusses a more specific variation of three focus points, which is in line with Harteveld (2011), of creating an engaging game, properly catering for the training objective and allowing the training context to influence design decisions. Essentially all of the authors highlight the importance of taking into consideration different perspectives and balancing them accordingly.

1.2.4. More concrete guidance in developing games

Viewing games from a multi-disciplinary can provide a lot of insights, but it does not make the life of a game designer much easier. More recently, authors have tried to propose frameworks that give more concrete guidance to the development of games. For example, Carvalho et al. (2015) present a step-by-step procedure for developing game components to satisfy high-level objectives. Arnab et al. (2015) aim to identify key "Serious Game Mechanics" for game designers to be able to choose from. They represent game components that combine gaming purposes and higher level-objective agendas. Kelle et al. (2011) developed a similar methodology but looks at the level of game design patterns rather than specific game components. Suttie et al. (2012) try to link specific game mechanics one-to-one to learning mechanics based on empirical evidence. They look at the game mechanics that have been successfully used in order to achieve certain learning mechanics. While these methods do provide a step in the direction of more concrete guidance, they do not provide complete guidance for designing awareness games. These methods focus only on game mechanics, which are important, yet only a part of the game design process as we illustrated in section 1.1.

1.3. Problem statement

As we have seen in the previous sections, the awareness game design literature deals with a number of different aspects in game design, from the process-based perspective methodologies to the game deconstruction models to the triadic perspective models. We can compare it to the difficulties we discussed in section 1.1. regarding awareness game design. In Table 2 we list an overview of the discussed game design issues and design methodologies that were discussed.

Table 2 List of discussed awareness game design issues and design methodologies

Awareness game design issues	Design methodologies
Translating field-specific knowledge	Design process sequence (Duke & Geurts, 2004)
Balancing focus on complexity of real world problem and learning outcome	Game-specific nuclei (Hunicke et al., 2004; Amory, 2007; Westera et al., 2008)
Inclusion of perspectives of different stakeholders	Triadic game design frameworks (Harteveld, 2011; Rooney, 2012; Winn, 2009; Frank, 2007)
Determining game elements	Concrete models for developing game mechanics/game design patterns (Carvalho et al., 2015; Arnab et al., 2015; Kelle et al., 2011; Suttie et al., 2012)
Determining appropriate game format	
Determining correct degree of abstraction	

Not one complete design methodology

Duke & Geurts (2004) provide a lot of the groundwork for the design process of awareness games. The game-specific nuclei models aid in communication and analysis surrounding game design. However, those methodologies do not tackle the difficulties awareness game designers currently deal with. Other design methodologies address some of these difficulties however. The triadic game design perspectives deal with balancing of the real world problem and learning outcome, as well as the inclusion of multiple perspectives. The concrete models help with determining some of the game elements (game mechanics specifically) and potentially how to translate field-specific knowledge into game elements.

However, we can see that not one of the design methodologies is complete in dealing with the difficulties for awareness game design. Different methodologies deal with different aspects of the game design process. It may be the case that the methodologies can complement each other in dealing with the various difficulties, but it is not necessarily trivial how those methodologies relate and how a designer of awareness games would have to choose between methodologies.

Lacking concrete guidance

Another issue, as Carvalho et al. (2015) identified, most of these methodologies focus on high-level aspects of game design that are difficult to satisfy concretely. For example, as we mentioned earlier, the triadic game design frameworks argue for the importance of balancing the real world case and the learning objective, but not how to concretely tackle the issue. Until the more recent methodologies described in section 1.2.4., the frameworks or methodologies were not developed with a perspective for concrete guidance. Duke & Geurts (2004) provide a more generalized process model. The models for breakdown of games into game-specific nuclei (Hunicke et al., 2004; Amory, 2007; Westera et al., 2008) were developed with a focus on communication and analysis, after and during game design. Frameworks such as Harteveld (2011), Rooney (2012), Winn (2009) and Frank (2007) were developed to highlight the importance of balancing different perspectives and the multi-disciplinary nature of games. Although there is a trend moving towards more concrete guidance in the game design literature, as we have seen in section 1.2.4., the concrete models are still far from providing complete guidance.

We thus summarize our problem statement as follows: There is not one complete design methodology and the existing design methodologies do not provide enough concrete guidance.

1.4. Research objective

As we mentioned in section 1.1, game design methodologies can be a huge benefit in designing games. However, in section 1.2. we found two issues with the game design methodologies for designing awareness games. Our research objective is to work towards a more comprehensive framework for the design of awareness games. We try to position the existing game design methods in that framework to generate a better understanding of where and how in the design process the various game design methods can be used. We can then also analyze in which parts of the design process we are still lacking in terms of concrete practical guidance. This brings us to the research question around which this thesis is centralized:

How can we integrate existing game design frameworks into a more comprehensive game design framework for awareness games?

To answer this research question we examine the following subquestions:

What roles can the existing game design literature play in providing more complete and concrete guidance for designing awareness games?

What framework can be designed to integrate those roles from the existing game design literature?

How is the developed framework evaluated in aiding with more complete and concrete guidance for the design of awareness games?

What can we learn from the design and evaluation of our framework for the design of awareness games?

1.5. Research design

The purpose of this research is an exploratory study for the better understanding of the design of awareness games. Based on our problem statement, we find that additional information is needed as the current game design literature is incomplete and lacks concrete guidance for designing awareness games. Our approach is an inductive one, as we look to develop a new theoretical framework.

We have chosen to adopt the Design science research paradigm in our research. Design science research is, in a broad sense, increasing knowledge and understanding through the act of building (Kuechler & Vaishnavi, 2008). It seeks to create innovations that define ideas and practices through which design, implementation, management and use of IS can be effectively and efficiently accomplished (Hevner et al., 2004). In other words, the basis of the research is to connect academic knowledge to practical relevance, through developing/building new theories or artifacts. To illustrate this, Hevner et al. (2004) developed a conceptual framework as shown in Figure 1. The framework depicts two "cycles", the relevance cycle and the rigor cycle. In the relevance cycle, the practical environment defines the problem space of the phenomena of interest. In that environment, business needs exist, which the researcher tries to address by developing an innovative theory or artifact aimed at tackling that need. The theory/artifact goes through an iterative process of building and evaluating. Once finished, it has to be evaluated with application in the appropriate environment. From the rigor cycle, the researcher draws from the existing knowledge base to develop that theory/artifact. The learnings the researcher draws from the iterative process of development and evaluation will add to the knowledge base for further advancement.

Design science research as we interpreted it (Hevner et al., 2004; Kuechler & Vaishnavi, 2008; Venable, 2006) is mainly used in Information Systems (IS) research. Nevertheless, we feel that the paradigm fits the context of awareness games and our research objective well. Firstly, our problem statement has roots on the academic side (design frameworks are incomplete) and the practical side (not enough concrete guidance). As with design science research, our research objective tries to develop an integrated framework that is more complete (add to knowledge base) and provides more concrete guidance (relevance to business need). Secondly, design science research in IS is aimed to create and evaluate artifacts intended to solve identified (complex/wicked) organizational problems (Hevner et al., 2004). This is very similar to how we introduced awareness games. Finally, in some ways, games can be thought of as IS (Salen & Zimmerman, 2004).

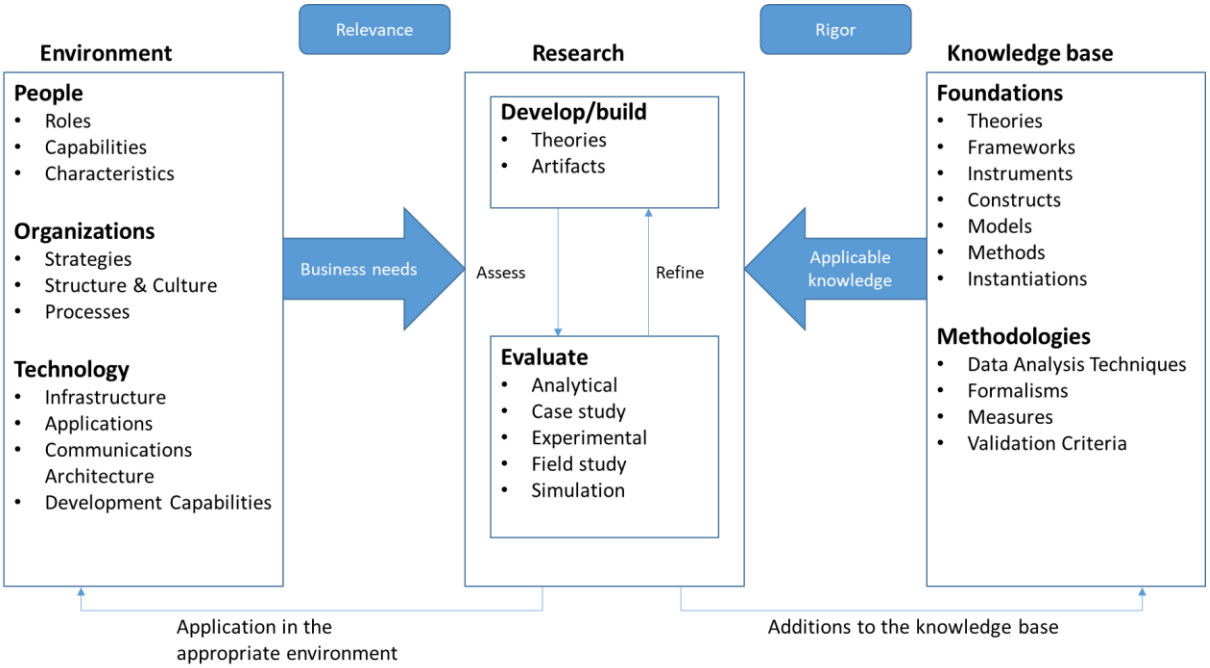

Figure 1 Design science research conceptual framework, illustrating the relevance and rigor cycle as presented in Hevner et al. (2004).

Research strategy

Venable (2006) presents a framework from the perspective of activities that should be performed by the researcher, as shown in Figure 2. The central activity is theory building, which is related to problem diagnosis, technology invention or design and technology evaluation. We have looked at a number of different research strategies to help perform those activities: case study, ethnography, content analysis, action research and grounded theory. Case study is a research strategy involving empirical investigation of a phenomenon within its real-life context, using multiple sources of evidence (Saunders et al., 2009). In our case it would mean researching the design process of entertainment game developers and identifying best practices from them. Ethnography is an inductive approach from the field of anthropology. It involves researching the phenomenon within the context in which it occurs (Saunders et al., 2009). This would mean observing the game design process from within a game development company. Content analysis is an observational research method used to analyze large amounts of textual information (Sekaran & Bougie, 2012). Similar to grounded theory, the text is coded into categories and then analyzed for characteristics such as frequency of occurrence. Its aim is to uncover “hidden” messages that can be found within texts. Action research has been interpreted in a variety of ways (Saunders et al., 2009). There are four common themes however in the literature: the focus on research in action, involvement of practitioners from the relevant environment, an iterative process (diagnosing, planning, taking action and evaluating), and using this to inform implications beyond the immediate project. Grounded theory uses a systematic set of procedures for the development of a theory from data in an inductive manner (Strauss & Corbin, 1990). It analyses data sources looking for meaningful ideas or phenomena that can be uncovered. These observations are reduced into small units of text called “codes”, which are then later grouped and used to form categories. This categorization is a process of organizing,

arranging and classifying the identified codes and requires creativity from the researcher. By interrelating and integrating these categories further, a theoretical framework can be constructed.

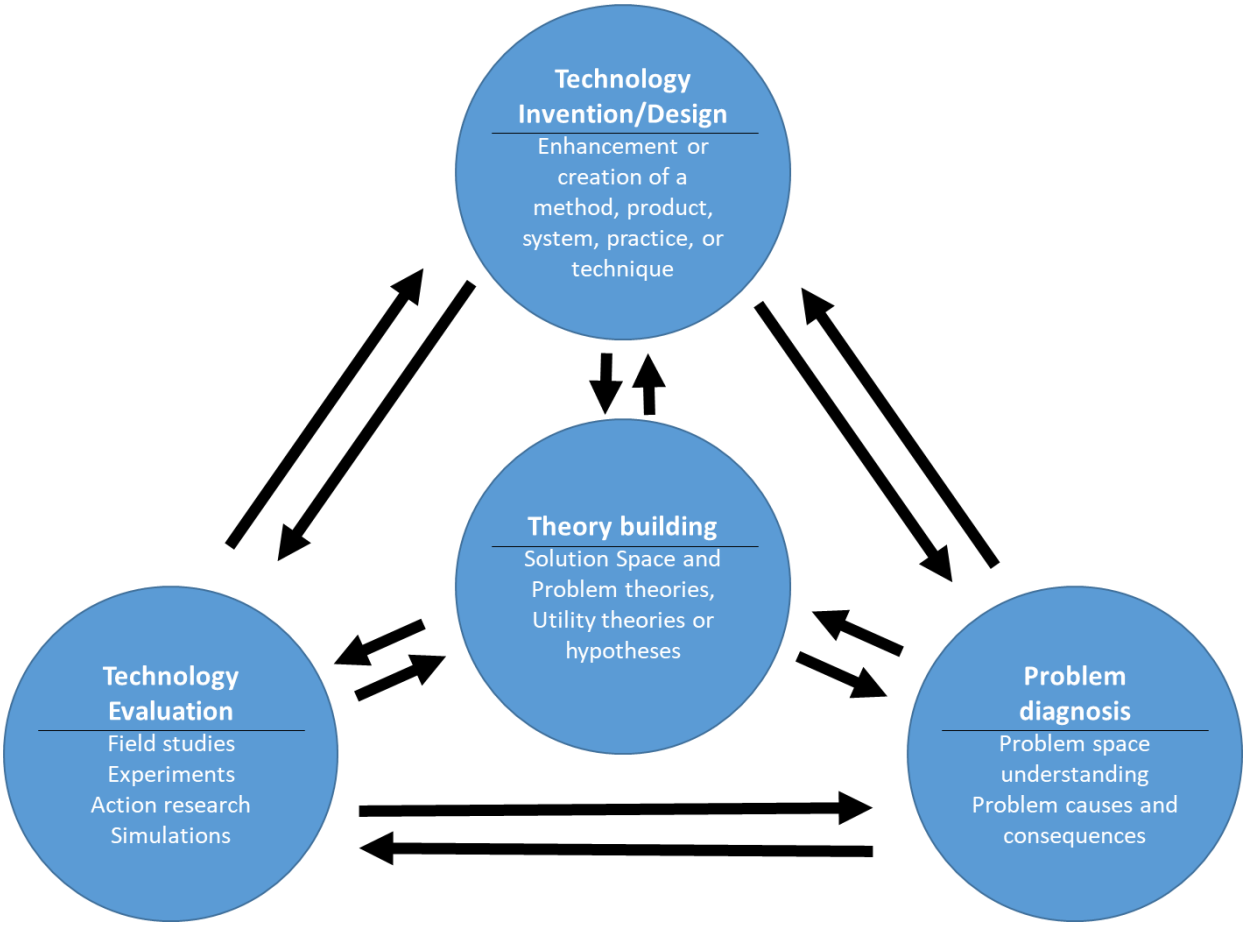

Figure 2 Activity framework for Design Science Research by Venable (2006), showing the activities in Design Science Research..

Below we explain how we aimed to perform the activities as described by Venable (2006) and our choice for the final research strategy.

The first activity we look at is the problem diagnosis. This was done for the most part in section 1.3. where we derived our problem statement. As we continue with the other activities, our understanding of the problem also increases.

The second activity is the design of our more comprehensive and integrated framework, in which we position and relate existing game design frameworks. We discuss the design in two parts. We first conducted a literature search, after which we analyse our sources and determine what role they can play in our framework. This corresponds to our first sub-question. We had to separate our treatment of the academic sources and the entertainment game design sources. Whereas the academic sources focus on specific points, the entertainment game design sources contained vast amounts of information. From this information, we had to extract the useful concepts for our purposes in order to integrate them into our framework. We find that this process is similar to grounded theory, in which a theoretical framework is

constructed by interrelating and integrating important concepts or categories. However, for our purposes, we found that the full set of systematic procedures in grounded theory would not be necessary. The academic awareness game design literature gives us an initial starting position to develop our framework. Additionally, the entertainment game literature is structured data, already categorized by experts in game design. In order to then integrate both of those sources into a coherent framework, we used a top-down approach from the academic game design literature, combined with a bottom-up approach from the entertainment game literature.

The third activity is the evaluation of the designed framework. Preferably, this would be done by applying it in the appropriate practical environment, for instance by means of field study, case study or action research. However, such an extensive research in the practical environment was not within the resources and scope of the research project. We still wanted to involve practitioners from the game design field and decided to conduct interviews with game design experts to provide feedback to evaluate the framework. Additionally, to add to the practical application, we analyzed a single case of a game design project conducted by the author that was executed prior to this research.

Finally, we discuss theory building by reflecting on the design framework, the process of its development and its evaluation to see what we can add to the knowledge base.

Limitations

The research design has several limitations. In terms of reliability, there are a few weaknesses in the design of the framework. Extracting the relevant concepts from the entertainment game design literature is reliant on the interpretation of the researcher. The developing process of the framework is also a creative one and will depend on the researcher executing it. In order to mitigate some of these weaknesses of the reliance on the researcher, we performed a check with a game design expert.

Another limitation of the research is that we only have theoretical sources on game design. We did not have access to quantitative data on how the game design process is executed in practice. Additionally, the designed framework was not evaluated in the practical setting due to time constraints. The validation of the framework in practice will have to be addressed in future research.

1.6. Thesis outline

The structure of the thesis is as follows. In Chapter 2 we review existing game design literature and examine what role they can play in designing a theoretical framework. In Chapter 3 we use the learnings from the literature to design a theoretical framework. In Chapter 4 the theoretical framework is evaluated through game design expert interviews as well as analysis of application on a game design project by the author. In Chapter 5 we reflect on the design process and evaluation in order to see what we add to the knowledge base. In Chapter 6 we present our conclusions and recommendations for further research.

Chapter 2: Roles of existing game design frameworks

In this Chapter, we analyze in-depth what role the existing game design literature can play in developing a more concrete and complete framework for designing awareness games. We performed a literature search[1] to find relevant existing game design frameworks. The Chapter is divided into two parts, with the first part being a review of the academic literature for designing awareness games, and the second part is a study on the entertainment game design literature.

2.1. Academic literature for designing awareness games

In this section, we discuss the current academic literature on designing awareness games. We examine existing frameworks and methodologies for designing awareness games. We provide an overview of the existing literature and reflect on what role they can play in developing a more concrete and complete design framework.

2.1.1. Analysis of existing literature on design of awareness games

In this section, we give an overview of the existing literature on the design of awareness games. We try to showcase the current landscape and summarize the work that has been done in various areas of the field. A more detailed description of the literature discussed below can be found in Appendix C.

The game design process

Duke & Geurts (2004) have done a lot of work on the design process of awareness games. Based on 30 years of practical and academic work, they developed a process based schematic, or design sequence as Duke & Geurts (2004) named it, for the design of awareness games as shown in Figure 3. The design sequence as depicted by Duke & Geurts (2004) consists of five phases. The first phase relates to setting up the project in conjunction with the client. The goals, constraints and expectations of the project are determined. In the second phase, the focus and scope of the project are further defined. A system model of the problem context is then developed. The system model consists of the components and interrelationships that are important in the context of the problem. The third phase is where the design of the game and much of the artistry takes place. The system model developed in phase two is used as a basis for the game design. Ideas for translating the system model into gaming elements can be generated by filling in a matrix of system components on one axis and game elements on the other, as shown in Table 3. Then follows a creative process to develop a concept. In the fourth phase, once the concept is settled on, it is further developed through an iterative cycle of building, testing and modifying a prototype. The final resulting prototype is evaluated and cross-checked with the initial specifications and completed

[1] The search strategy used multiple channels of information. Firstly, several papers had already been collected from literature made available at a game design course at the TU Delft. Secondly, we used the databases Scopus and Web of Science, as well as the journal recommended by experts “Simulation and Gaming” to find other main literature. The keywords “Game AND design AND (framework OR approach OR process OR theory)” were entered in the fields “Article title, Abstract, Keywords” (Scopus) and the field “Topic” (Web of Science). Thirdly, we used forward snowballing from papers found by the previous two channels and from papers found in the literature review in Chapter 2. Fourthly, we consulted game designers at the game design course and Gamelab of the Delft University of Technology for recommendations. Finally, we checked any additional literature available at the nearby libraries.Using this search strategy we have found 25 academic papers and seven books on entertainment game design matching our criteria.

with the graphics design. The fifth and final phase is where the game is integrated for implementation with the client.

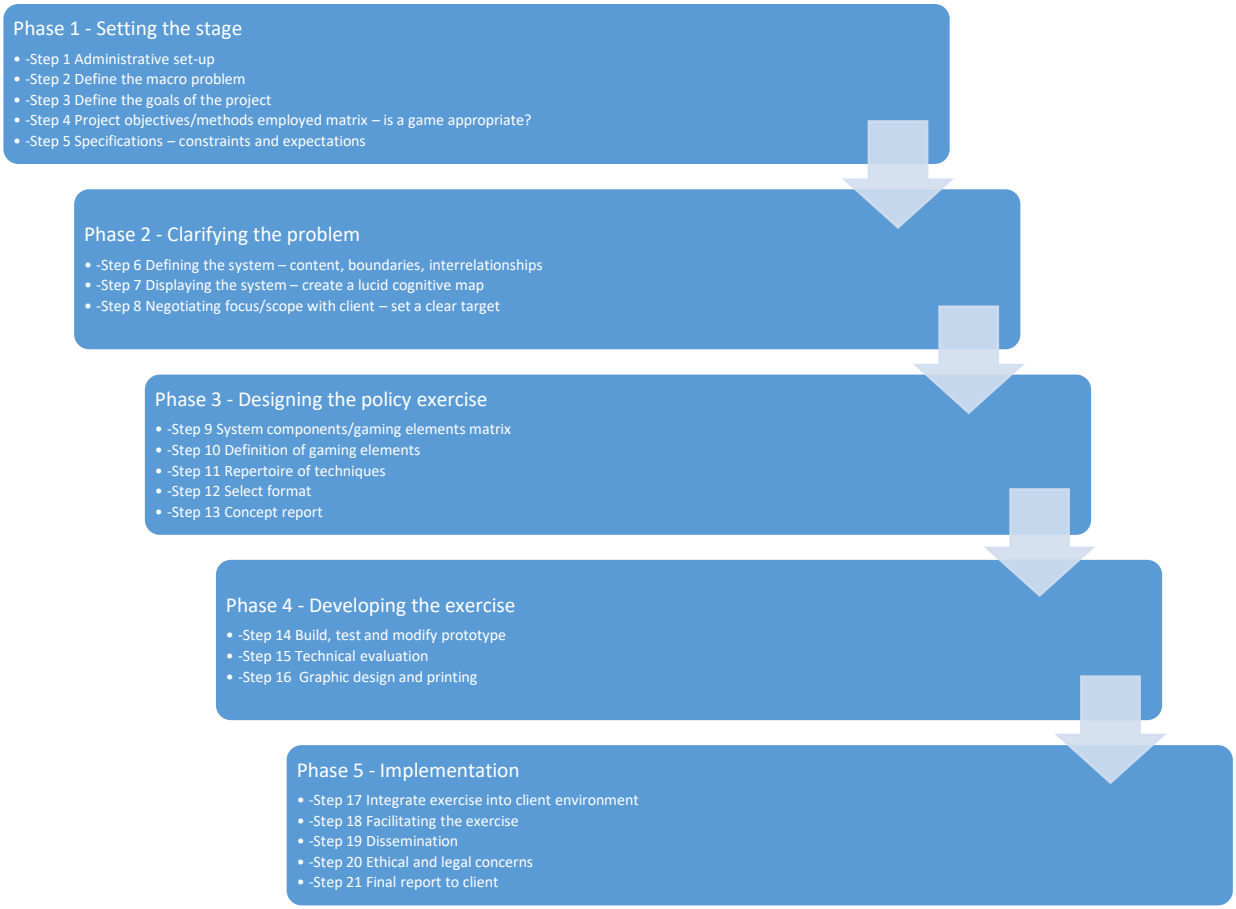

Figure 3 Illustration of design sequence by Duke & Geurts (2004), divided into five phases and 21 steps.

The design sequence as laid out by Duke & Geurts (2004) is also featured in other papers. Wenzler (1997) provides somewhat of a precursor to the work of Duke & Geurts (2004), based on shared experiences between Wenzler and Duke. Peters & Van de Westelaken (2014) use a slightly adapted, more condensed, version according to their practical experience in the field.

Table 3 Example of a matrix of system components and game elements by Duke & Geurts (2004)

	System components		
Game elements	**Budget**	**Decision makers**	**Production processes**
Scenario			
Events			
Roles			
Rules			
Visuals			

Kortmann & Harteveld (2009) compare the design sequence by Duke & Geurts (2004) to software development design sequences. Due to an increase in complexity of software development projects, there is a trend towards applying agile development models. Kortmann & Harteveld (2009) suggest to use agile development models for game design as well, see Figure 4. Instead of the "waterfall", step-wise sequence, of the five design phases by Duke & Geurts (2004), the agile development model is a more iterative process. Such a model would improve the design process as the model is better able to explore the client's needs and possible solutions. The agile model is also much more flexible in case adaptations are required, leading to increased efficiency during development. Within their model Kortmann & Harteveld also incorporate ideas from Triadic Game Design, which calls for balancing of elements of Reality, Meaning and Play in parallel. We will elaborate on Triadic Game Design in the paragraph of multi-disciplinary models further below.

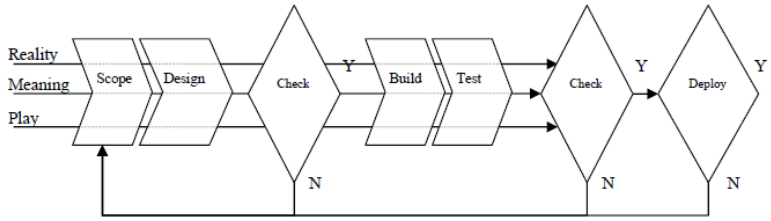

Figure 4 Agile development model for game design as suggested by Kortmann & Harteveld (2009).

The design sequence by Duke & Geurts (2004) and the agile design process schematic by Kortmann & Harteveld (2009) can be used to define the structure of the design process.

Game-specific nuclei, a common vocabulary for games

Duke & Geurts (2004) themselves felt that an important part to furthering the field is to improve communication about games, within the gaming field as well as towards the clients. From their own practical experience, they found that the client subject matter is extremely diverse and that their products thus have rather dissimilar characteristics. In order to improve communication and analysis of such games, they advocated for the development of a common vocabulary of game-specific nuclei, building blocks or core elements of games. Several authors have proposed models for deconstructing games into game-specific nuclei. Hunicke et al. (2004) developed their MDA (Mechanics, Dynamics and Aesthetics) framework, which breaks games down into its Mechanics, Dynamics and Aesthetics. It takes the perspective of how players interact with games. The mechanics are the particular components of games at the level of data representation and algorithms. The dynamics are the run-time behavior of mechanics as they respond to player inputs. Aesthetics of a game are those desirable emotional responses evoked in a player when they interact with the game system (e.g. fantasy, discovery, challenge). Amory's (2007) Game Object Model version II takes a different perspective and looks more at the different components of games and their internal interactions. The model essentially provides a large number of game components that are grouped in several larger categories of components Amory calls "Spaces". Westera et al. (2008) take yet another perspective of deconstructing games and divides the design of games into three levels: conceptual, technical and practical. The conceptual level relates to the gameplay world, the technical level to tools that allow the game to be developed and implemented and the practical level to design principles that aid in the design process. Hunicke et al. (2004) their MDA framework, Amory's

(2007) Game Object Model version II and Westera et al. (2008) their deconstruction can play a role in providing a common vocabulary for game design.

Objective focused models

Rather than focusing solely on the game artifact, several authors also highlight the importance of integrating models of different fields into the game design process that relate more to the objective of a game. There are for example a lot of attempts to integrate pedagogical theories into game design (Kiili, 2005; Kiili 2014, Ibrahim & Jaafar, 2009; Aleven, 2010; Starks, 2014; Ahmad, 2015). A more detailed description of how they do so can be found in Appendix C. Bots & Van Daalen (2007) focus on the intended policy activities of the game. They list various policy activities and help to match them with specific game properties. These models play a role in integrating the objective into the design process for specific contexts, such as learning or policy activities.

Triadic design frameworks

Other authors argue that yet another aspect has to be taken into account. While these authors use different arguments and have different focus points, they all propose a form of triadic framework. They describe factors in relation to the problem specific context, aside from the (learning) objective of the game and the game play experience, see Table 4.

Table 4 Comparison of triadic frameworks calling for multi-disciplinary perspective of game design.

Author(s)	Factors in relation to problem specific context	Factors in relation to (learning) objective of the game	Factors in relation to game play
Frank (2007)	Allow context to influence design decisions	Cater for training objective	Create an engaging game
Harteveld (2011)	World of Reality	World of Meaning	World of Play
Winn (2009)	Content expert perspective	Academic perspective	Game designer perspective
Rooney (2012)	Fidelity	Pedagogy	Play

Frank (2007) discusses a pragmatic design approach with three specific design goals to be considered in parallel. Creating an engaging game, catering for the training objective and allowing context to influence design decisions. Harteveld (2011) describes similar ideas, but in a more generic manner. In his work on Triadic Game Design, Harteveld (2011) mentions that three different “Worlds” have to be taken into account simultaneously: Reality, Meaning and Play. Each of these Worlds have different aspects, people, criteria and disciplines to consider. Winn (2009) with his DPE (Design, Play, Experience) framework approaches this specifically from the people perspective. In his view, the “heart” of game design is where the theoretical/academic perspective, the content expert perspective and the game designer perspective overlap. Rooney (2012) focusses on a specific theoretical perspective of pedagogy and what this means for the design process. She argues for the balancing of play, pedagogy and fidelity and discusses what theoretical underpinnings are associated with them. Rooney (2012) makes an important observation however that while there is a rich theoretical basis for the importance of the various perspectives, actually

balancing those perspectives during the design process is practically and theoretically still very difficult. This is something we also experienced in our own practice, as mentioned in the previous Chapter.

Models for more concrete design oriented guidance

Carvalho et al. (2015) also make the observation that the literature on game design focusses mostly on high-level aspects and they do not really help to understand how to satisfy those high-level requirements in concrete manner. They developed a step-by-step procedure to analyze whether gaming and objective related components are integrated sufficiently. It starts with analyzing the activities a player would undergo during game play and what the actions, tools, and goals related to those activities are. These are then looked at from three different perspective: game play, the objective of the game and contextual factors. This structured way of analysis can then help in the prototyping phase to shed light on possible weak points in the design and address them accordingly.

Several other authors have tried a more direct approach at providing more concrete guidance. Kelle et al. (2011) try to link established game design patterns, commonly recurring game components, to related learning objectives. Suttie et al. (2012) and Arnab et al. (2015) take a similar approach as Kelle et al. (2011), but look at a slightly more detailed level of game mechanics and relate that to the learning objectives, which they name Learning Mechanics-Game Mechanics models (LM-GM model). The idea is that game designers can more easily choose those game design patterns and/or mechanics, based on the learning objectives the game is supposed to achieve. It is, however, a simplistic idea to think that simply plugging in certain game mechanics will lead to learning objectives being attained through a game. A game is more than the sum of its game mechanics. The various components have to come together in such a way that when the player interacts with them, a meaningful experience is generated (Salen & Zimmerman, 2004). These models can play a role in deciding how to develop game mechanics.

Assessment and validation models

Finally, we discuss some papers that can play a role on the assessment and validation of games. Mitgusch & Alvarado (2012) breakdown games into 5 core components: Content/information, Fiction & narrative (Characters, plot), Mechanics (Learning curve, rules, goals, rewards, verbs), Aesthetics & graphics (Setting, visualization) and Framing (Play literacy, topic, audience). Subsequently, these components are then further assessed for whether they present a coherent and cohesive game system that should relate to the game's purpose. This model can also be used to evaluate and improve prototypes during the game design process. Serrano-Laguna et al. (2017) have a more innovative way of evaluation, which may only be suited for specific games. It involves integrating the implementation of in-game analytics into the design of the game that tracks the players' behaviour. Warmelink (2016) proposes that validation of games is also to be integrated throughout the game design process, instead of after the game is (almost) completed. He provides a set of tools to check for different types of validity.

2.1.2. Connecting the roles of existing literature in developing a design framework

Now that we have established the current landscape of literature on game design and the individual roles they can play, we try to connect them as part of a more comprehensive design framework.

Three levels of abstraction

We find that the existing methodologies can be categorized based on their varying levels of abstraction at which they deal with game design. We identify three different levels, which we will address as the contextual (high) level, procedural (medium) level and developmental (low) level. We define the contextual (high) level perspective as looking at the context/external factors surrounding the game design process, the game design process as a whole, the means a designer has for the input of the design process, as well as the criteria for the output of the design process. The procedural (medium) level perspective looks at the inner workings of the game design process, how the game design process connects input to output, the phases or steps within the game design process and how they should be organized. The developmental (low) level perspective takes a look at concrete design decisions within a certain phase of the game design process. An illustration of this can be found in Figure 5.

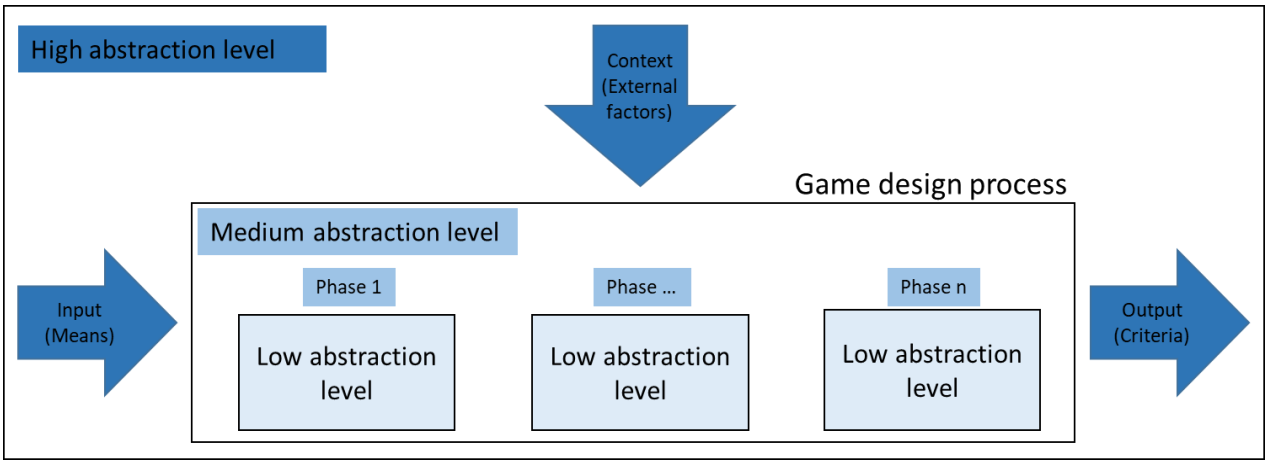

Figure 5 Illustration of different perspectives on the game design process based on their abstraction level.

Contextual (High) level

At the contextual level we find those frameworks that provide more of a theoretical basis surrounding the design process.

The objective focused frameworks can be used as input for the design process. These frameworks give recommendations for the design process to reach better results for certain objectives. Not all of them can be used in all cases as their focus is more content specific. For example, Ibrahim & Jaafar's (2009) framework is better suited towards larger scale (classroom) type learning, whereas Bots & Van Daalen's (2007) framework is aimed at games for policy development.

Then we have the external factors that do not necessarily directly influence the design process. There are several frameworks that can be used for communication, and each of them provides a different angle from which to communicate about games. Depending on the receiver and the content of what is to be communicated, each of these could be used. There are also the triadic design frameworks that serve as a

way of looking at the design process. Perhaps Harteveld's (2011) description of the triadic framework as a design philosophy is most accurate. Throughout the whole process, there is a need for checking whether there is a balance between the content, objective and game play factors.

The evaluation and validation methods can be used for straightforward purposes of evaluating the prototypes or the end result and checking their validity.

Procedural (Medium) Level

At the procedural level we find the frameworks that deal with the structure, the steps and phases, of the design process. Duke & Geurts (2004) and related frameworks play a large role. They have developed a standard framework for design process regarding awareness games. Kortmann & Harteveld (2009) provide an interesting adaptation that can modernize the design process to be more flexible.

Developmental (Low) level

At the developmental level we find those frameworks that relate more to the concrete design steps to follow in the design process. Unfortunately, the concrete development frameworks are rather limited to game mechanics. Carvalho et al. (2015) developed a process for developing game mechanics in order to relate them better to the objective. The other methodologies are also relating game mechanics or game design patterns to learning mechanics or learning functions. With game mechanics and game design patterns only however, we cannot construct a full game. There are many more elements to consider and they have to come together to make a complete game.

Table 5 Overview of reviewed frameworks based on abstraction level and their potential role in developing an integrated design framework.

Contextual (High) level			
Input	**Context**		**Output**
Objective focused - Content specific theories (Kiili et al., 2005, 2014; Bots & Van Daalen, 2007; Ibrahim & Jaafar, 2009; Aleven et al., 2010; Starks, 2014; Ahmad et al., 2015)	**Common vocabulary for design** (Hunicke et al., 2004; Amory, 2007; Westera et al., 2008)	**Triadic design perspectives** (Frank, 2007; Harteveld, 2011; Winn, 2009; Rooney et al., 2012)	**Evaluation & Validation** (De Freitas et al., 2006; Mitgusch & Alvarado, 2012; Warmelink et al., 2016; Serrano-Laguna et al., 2017)
Procedural (Medium) level			
Game design process (Wenzler, 1997; Duke & Geurts, 2004; Peters & Van de Westelaken, 2014)		**Agile design process schematic** (Kortmann & Harteveld, 2009)	
Developmental (Low) level			
Choosing game mechanics related to learning mechanics (Suttie et al., 2012; Arnab et al., 2015)	**Choosing game patterns related to learning functions** (Kelle et al., 2011)	**Developing mechanics related to higher-level objective** (Carvalho et al., 2015)	

2.1.3. Summary on awareness game design literature

To conclude this section, we summarize our main findings here. The existing literature on awareness game design was reviewed and we summarized the current landscape. Then we looked at what role the literature can play in developing a more comprehensive design framework. We found that the identified roles could be categorized in three different abstraction levels: contextual (high) level, procedural (medium) level and developmental (low) level. At the contextual level we find objective-focused methods, frameworks for common game design vocabulary, triadic design perspective models and methods for evaluation and assessment. At the procedural level we find process-based models for game design. At the developmental level we find more concrete models oriented at developing game mechanics and game design patterns. We find that this level is underdeveloped, as other elements of game design are not dealt with. In the next section we aim to fill that gap and look beyond the awareness game design literature, towards the entertainment game industry best practices, who are much further ahead in this area.

2.2. Analysis of entertainment game design literature for the development awareness games

In this section, we analyze the role that the entertainment game design literature can play in the development of a more comprehensive framework. Firstly, we describe the research process of how we extracted the most important concepts from the literature. Then we present the results of that analysis.

2.2.1. Research process

As we mentioned in section 1.5., we use techniques from grounded theory to help extract the most important concepts from the entertainment game design literature. We look to integrate learnings from entertainment game literature into the initial framework we developed for the design of awareness games. We have based our research process on the work by Staalduinen (2012), who used grounded theory in his dissertation to develop a framework for educational game design. We chose to do so, as his work is similar to what we aim to achieve, except he focusses on educational games. The research process starts out with the coding process. The codes are organized and arranged into larger categories. Then we examine the categories for which of them can be merged in case they are very similar. We analyze the remaining higher level categories for their applicability to awareness game design. Finally, we look at how those categories are interrelated and can be integrated into our initial framework from the previous Chapter.

Open coding process

The first step of the research is the open coding process, where the textual data is analyzed to identify and label meaningful concepts. This step requires some creativity from the researcher to interpret the data and extract relevant information for the research. The researcher also needs to find the right abstract definition to label those bits of information, which is referred to as a "code". Those codes are the elementary building blocks used to help form our design framework. The aim of the open coding process is to identify and extract as much relevant information from the data as possible.

Axial coding process

The next step is the axial coding process, where the codes are arranged and organized in order to find overarching central themes. The process starts with grouping together the codes to form aggregated concepts that represent more complex phenomena, named categories. Staalduinen (2012) mentions that literature on grounded theory uses the term subcategories to denote categories belonging to another specific category. Staalduinen (2012) himself uses the term supercategory as an umbrella term, that groups several other categories that are related to each other. We found that these terminologies could be rather confusing when the data showed more than four layers. For clarity purposes, we introduce the term "conceptual level". The highest level umbrella categories are denoted under conceptual level 1. Their subcategories are denoted under level 2, with their branches being denoted under level 3 and so on. The axial coding process results in "trees" of concepts and categories for each of the game design literature that was studied. The grouping of codes to form categories generally requires some creativity from the researcher. In our case it was made simpler since the literature we studied is pre-structured.

Coding schematic

Since the literature is mainly pre-structured we, followed the structure in the literature for our coding schematic. This meant we followed the following coding schematic:

- Modules
- Chapters
- Sections
- Paragraph titles
- Bold/Italic or bullet points

We limited our coding to texts related to conceptual game design from the designer perspective. We filtered texts on game development, the actual construction of the game artifact as how it was designed, as this topic is outside of the scope of this thesis. Furthermore, we filtered examples and cases that serve to highlight other concepts mentioned in the texts, since they do not add any new concepts. Below we will provide an example of the open and axial coding process as was done for a section in Adams & Rollings (2007).

Example of open and axial coding process

The first chapter of Adams & Rollings (2007) deals with the essential elements of games. They define them as play, pretending, goal and rules. They present various uses of the word play in the English language and use the term in all its broadness. Pretending relates to Huizinga's (1955) work on the "magic circle". Games are also characterized by having a goal, as opposed to goalless play. Adams & Rollings (2007) once again take the definition of goal in a very broad sense. Rules are broken down into various specific terms: semiotics, gameplay, goals, termination conditions and metarules.

Coding this section led us to formulate a level 1 category of "game elements" with branching level 2 categories of "play", "pretending", "goal" and "rules". For the purposes of game design we did not think the broad definitions for play, pretending and goal were very relevant. The specific breakdown of rules , however, might be interesting to think about during game design. In a later section, "gameplay" was further elaborated on and we added those concepts as level 4 codes under "gameplay". The results of the coding process for this section could be seen as in Table 6.

Table 6 Excerpt from the axial coding process of Adams & Rollings (2007).

Adams & Rollings
1) Game elements i) Play ii) Pretending iii) Goal iv) Rules (a) Semiotics (b) Goals (c) Termination condition (d) Metarules (e) Gameplay 1. Challenges 2. Actions 3. Fairness

Once this process is done for all the entertainment game design literature, we can compile the high level concepts (levels 1-2). We then merge overlapping concepts between the different literature sources. This requires judgment by the researcher, whether the concepts described in the various sources are sufficiently similar. In case merged concepts have different lower level branches, we chose to add them together in order to preserve that information. Based on the merged list of high level concepts we can analyze what role they can play in forming a theoretical framework. The integration of these concepts, together with the results from section 2.1. will be dealt with in the next Chapter.

2.2.2. Results of inductive research method on entertainment game design literature

The open coding phase resulted in the identification of 2219 codes. The full results of this step can be found in Appendix D, section D1. The next step involved taking the high level categories (level 1 and level 2) from each of the literature sources, which can be found in Appendix D, section D2. This step resulted in 168 identified high level categories. We then merged any overlapping categories, the results of which can be found in Table 7 below. This led to the following nine major merged categories:

- Game design core concepts – These categories give us an idea of what is important in the design of entertainment games, or in other words, the philosophy and goal of game design. Player-centric design is an important concept connected to generating meaningful, interesting interactive and fun play.
- Design process structure – These categories show important concepts in relation to the structure of the design process, the phases and steps in the design process and iterative/cyclical design.
- Design process components – These categories show important components within that design process, such as developing core mechanics, interface design, balancing, prototyping, playtesting and idea generation.
- Game elements – These categories show which elements to design for during the design process. We find various ways to break down those elements. Adams & Rollings (2007) approach it more from a player perspective. Fullerton (2008) uses a system's perspective, in which the described elements are more about the underlying mechanics of the system. Schell (2008) takes more of an approach from the designer's perspective, as to the elements the designer has to take into consideration.
- Engagement / entertaining elements – These categories show the factors that can contribute to generating an engaging and entertaining experience, which is crucial to player-centric design.
- Player experience – These categories show factors that influence the player experience in other ways, aside from engaging and entertaining elements. Bateman & Boon (2006) primarily describe the impact of the audience, the type of player, on how the game is experienced. Schuytema (2007) describe other perceptions and emotions a player might have during the game that influence the experience in different ways.
- Game world – These categories relate to those components that deal with creating the game world abstraction. This deals with the alternate reality created by the game.
- System / structure – These categories show various ways to structure games.
- Common vocabulary – These categories highlight the importance of a common vocabulary, a way of communicating about games and game design.

Table 7 Resulting nine core categories from the various entertainment game design literature sources after merging overlapping categories.

1. Game design core concepts					
Adams & Rollings (2007)	Fullerton (2008)	Schell (2008)	Bateman & Boon (2006)	Salen & Zimmerman (2004)	Rollings & Morris (2007)
Player-centric design	Playcentric design	Goal	Philosophy	Meaningful play	Original
			Foundation	Design	Coherent
				Systems	Interactive
				Interactivity	Interesting
				Defining games	Fun
				Defining digital games	
				Magic circle	

2. Design process structure				
Adams & Rollings (2007)	Fullerton (2008)	Salen & Zimmerman (2004)	Rollings & Morris (2007)	Schuytema (2007)
Structure	Prototyping	Iterative design	First concept	Development cycles
Design stages	Playtesting		Core design	Design phase
	Iteration		Detailed design	Project phase
	Conceptualization			

3. Design process components			
Adams & Rollings (2007)	Schell (2008)	Bateman & Boon (2006)	Rollings & Morris (2007)
Core mechanics	Theme	Interface design	Game balance
User interface	Ideas	Basics	
Balancing	Choosing idea	Action space	
	Player	Immersive menus	
	Interface	Tutorials	

4. Game elements		
Adams & Rollings (2007)	Fullerton (2008)	Schell (2008)
Play	Players	Mechanics
Pretending	Objectives	Story
Goal	Procedures	Aesthetics
Rules	Rules	Technology
	Resources	
	Conflict	
	Boundaries	
	Outcome	

5. Engagement/Entertaining elements		
Adams & Rollings (2007)	Fullerton (2008)	Schuytema (2007)
Gameplay	Challenge	Receptiveness
Aesthetics	Play	Expectations
Harmony	Premise (context)	Subjective likes
Storytelling	Character	Ingredient X

Risks and Rewards	Story	
Novelty	World building	
Learning	Dramatic arc	
Creative and expressive play		
Immersion		
Socializing		

6. Player experience	
Bateman & Boon (2006)	Schuytema (2007)
Audience	Perception
Demographic	Emotions
Player typology	Challenge
Demographic Game Design 1 model	User Interface
Player abilities	Environment design
	Conflict design
	Game flow design
	Storytelling

7. Game world	
Bateman & Boon (2006)	Rollings & Morris (2007)
Components	Ambience
Motivations for abstraction	Interface
Abstractions	Storytelling

8. System/Structure			
Fullerton (2008)	Bateman & Boon (2006)	Salen & Zimmerman (2004)	
Elements	Game structures	Game design schemas	Patterns of complexity
Dynamics	Gameplay related	Rules	Theoretical aspects
Interaction	Toyplay	Play	Practical aspects
	Techniques	Culture	Fundamentals
	Save game functionality		

9. Common vocabulary	
Schell (2008)	Salen & Zimmerman (2004)
Definitions	Training
Play	Generational transfer
Game	Audience-building
	Buffer against criticism

2.2.3. Summary on entertainment game design literature

In this section, we analyzed the entertainment game literature could play in the development of a more comprehensive framework for awareness games. The research process was based on grounded theory techniques, using a coding process to extract meaningful concepts from the various literature sources. After categorizing and merging overlapping categories, this led to the identification of nine major categories important for game design. In the next Chapter, we look at how those categories can be used in developing an integrated framework

Chapter 3: Towards a comprehensive and integrated design framework

In this Chapter, we discuss the design part of our design framework for awareness games. We integrate the results of the analysis on existing game design literature from sections 2.1. and 2.2. to work towards a more comprehensive design framework. We firstly describe the methodology and the development process of the design framework. Then we present the resulting design framework.

3.1. Method used for developing the design framework

For the development of the design framework, we used the analysis of the existing game design literature from Chapter 2. We tried to integrate the methodologies from section 2.1. as well as the important concepts and categories identified in section 2.2. This integration process required creativity from the researcher to try and fit the various pieces together.

We used the initial structure as identified in section 2.1.: the contextual, procedural and developmental level. We started by developing the procedural level, as it represents the core structure of the game design process. In section 2.1.2. we identified that the design methodology by Duke & Geurts (2004) and related methodologies primarily form the procedural level. Thus we use the design methodology by Duke & Geurts (2004) as the basis and build from there in order to integrate the other results from Chapter 2. We examine the results from section 2.2.2. to see what additions can be made to the procedural level from the entertainment game industry literature.

Then we looked at the procedural-contextual level and procedural-developmental level interfaces, in order to see how the various levels can be connected. Using the analysis from 2.1.2. around the contextual level, we form the basis of the contextual level. Then we examine the results from section 2.2.2. to see how the entertainment game industry literature can add to the contextual level. The developed contextual level is then connected to the procedural-contextual level interface. Finally, we did the same for the developmental level as we did for the contextual level.

Once this process is done and an initial framework is developed, it is evaluated with several game design experts to check whether they agree or disagree with decisions in the process and how the framework is developed. The evaluation of the content and use of the framework will be dealt with in the next Chapter.

3.2. Development process of the design framework

In this section we illustrate the development process of the design framework. We start with showing the procedural level, the procedural-contextual level interface and the procedural-developmental interface. Then we discuss the contextual level and how it connects to the procedural-contextual level interface. Finally we discuss the developmental level and how that connects to the developmental-contextual level interface.

3.2.1. Procedural level

We start the procedural level with trying to define the core structure of the design process. From section 2.1. we find the game design process described by Duke & Geurts (2004) and related methodologies by Wenzler (1997) and Peters & Van de Westelaken (2014) at the procedural level. As we have discussed in section 2.1.2, they identify five design phases:

1. Design specifications
2. System analysis
3. Game design

4. Game development
5. Implementation/transfer to the client

From the results of section 2.2.2., we find that the second merged category from Table 7 "Design components and processes" relates to the design process. From Table 7 we can identify several categories that deal with structure and phases of the design process. In addition, for clarity purposes we elaborate one lever lower regarding the "design stages" (Adams & Rollings, 2007) and "development cycles" (Schuytema, 2007). We summarize these findings in Table 8.

Table 8 Design process structure related categories from section 2.2.

Adams & Rollings (2007)	Fullerton (2008)	Salen & Zimmerman (2004)	Rollings & Morris (2007)	Schuytema (2007)
Design stages -Concept stage -Elaboration stage -Tuning stage	-Conceptualization -Prototyping -Playtesting -Iteration	-Iterative design	- First concept - Core design - Detailed design	**Development cycles** - pre-production - production - post-production - Design phase - Project phase

Further detail can be found in Appendices C and D for awareness game design and entertainment game design literature respectively.

When combining the design phases as discussed in section 2.1.1. with the results from Table 8, we can identify three stages in the design process:

- Concept / initiation stage – This stage includes all the preparatory work before the game can be developed. From section 2.2., we find that the entertainment game industry all start with conceptualization, building the concept and/or core design. In the case of awareness game design, this is preceded by two more phases of design specifications and system analysis.
- Elaboration / production stage – This stage includes all the phases for the development of the game. All the sources are in agreement that this stage consists of an iterative process of prototyping and playtesting. Based on the evaluation of the playtest, the prototype is modified until a satisfactory game is developed. Rollings & Morris (2007) make one distinction and include the use of a more detailed design phase as opposed to the concept design.
- Implementation / post-production stage – This stage includes all the phases once the development of the game is completed. For awareness game design this stage is more elaborate than in entertainment game design, since the end user is very different. Awareness games will have to deal with delivery, facilitation and game play, as well as debriefing and evaluation. Adams & Rollings (2007) and Schuytema (2007) add for further development in terms of tuning and additional content.

Iterative design cycles

In section 2.1.1. we further identified an agile design process schematic (Kortmann & Harteveld, 2009) at the procedural level, see Figure 4.

The agile design process schematic is consistent with the three stages we identified above. The concept /initiation stage is consistent with the scope and design phases of the schematic. The elaboration / production stage is consistent with the build and test phase. The implementation / post-production stage is consistent with the deploy phase. The schematic prescribes to insert multiple checks after each of the stages.

From the entertainment game industry literature results in Table 7 we also find that iterative design is an important concept (Fullerton, 2008; Salen & Zimmerman, 2004; Schuytema, 2007). In addition, at the lower level detail, we find more categories related to iterative design, which we highlight below in Table 9.

Table 9 Lower level trees from entertainment game design literature analysis related to iterative design.

Adams & Rollings (2007)	**Schell (2008)**
1) Design components and processes i) Design stages (a) Elaboration stage 1. Build 2. Test 3. Iterate	1) Game design setup i) Choosing idea (a) Iterate 1. Risk assessment 2. Prototype 3. Playtesting
Rollings & Morris (2007)	
1) Detailed design i) Fitting design to development (a) Iterative spiral process 1. Tiers 2. Test beds	

We note that in the entertainment game design industry literature, iterative design is a recurring category. It is also generally done in the production stage with prototyping and playtesting phases. In awareness game design, there are additional phases in the concept / initiation stage (specifications and system analysis) that warrant iteration as well.

Combining the iterative design cycles with the stages and phases can be summarized as follows in Figure 6.

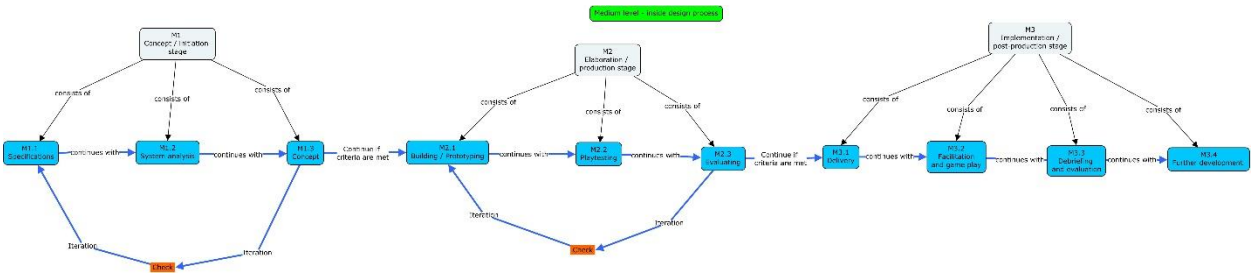

Figure 6 Initial shaping of the procedural level

3.2.1.4. Interface between procedural and contextual level

Now that we identified the core structure of the design process we look at the interface between this structure and the contextual level. In section 2.1.2. we divided the contextual level into input, context and output. For a detailed description of the various methodologies we refer to Appendix C. Regarding the input at the contextual level, we find the content specific theories. In a general sense, they focus on attaining specific objectives. Regarding the context at the contextual level, we find methodologies for common game design vocabulary and triadic design perspective frameworks. They focus on communication surrounding the design process and how to approach the design process. On the output side, we find evaluation and validation methodologies that focus on assessing the resulting game.

In section 2.1.2. we mentioned that these methodologies at the contextual level work at a high abstraction level. As Carvalho et al. (2015) mention, it is unclear how to concretely satisfy their requirements. We propose to use them exactly for those requirements, as the criteria within the design process. These criteria can be used for the checks for the iterative design cycles we identified earlier.

3.2.1.5. Interface between procedural and developmental level

The developmental level consists of the concrete steps to take during the design process. The concrete steps result in (intermediate) products, such as the design specifications or a system model (Duke & Geurts, 2004). These products are used in the next phase of the design process, for example, the design specifications are used in the system analysis to develop a system model. We can thus use them as the interface, connection the design phases of the procedural level and the concrete steps from the developmental level. We will elaborate on the specific products in section 3.2.3. when we discuss the developmental level.

The procedural level, the criteria from the procedural-contextual level interface and the products from the procedural-developmental level interface can be depicted as in Figure 7.

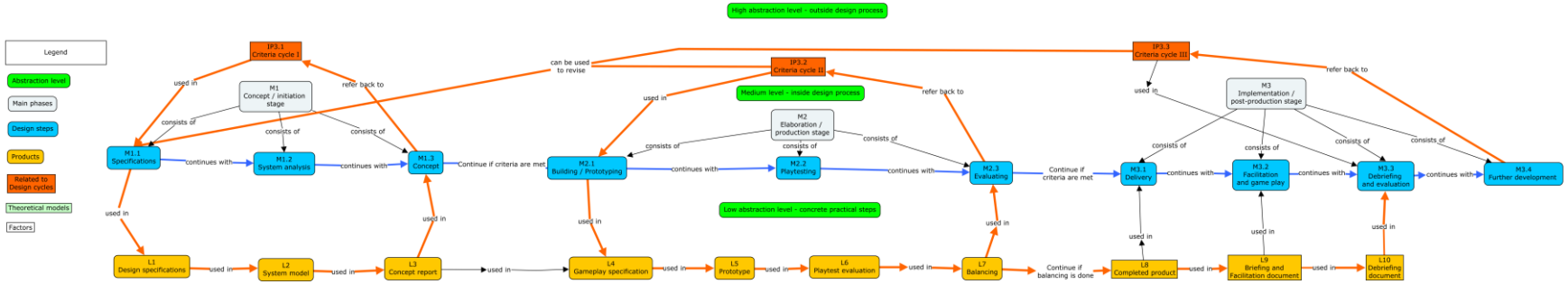

Figure 7 Depiction of the procedural level. The design steps are shown in blue, the internal structure is depicted by the orange arrows. The procedural-contextual interface is denoted by orange blocks and represent the cycle criteria. The procedural-developmental interface is denoted by yellow blocks and represent products/deliverables to be developed.

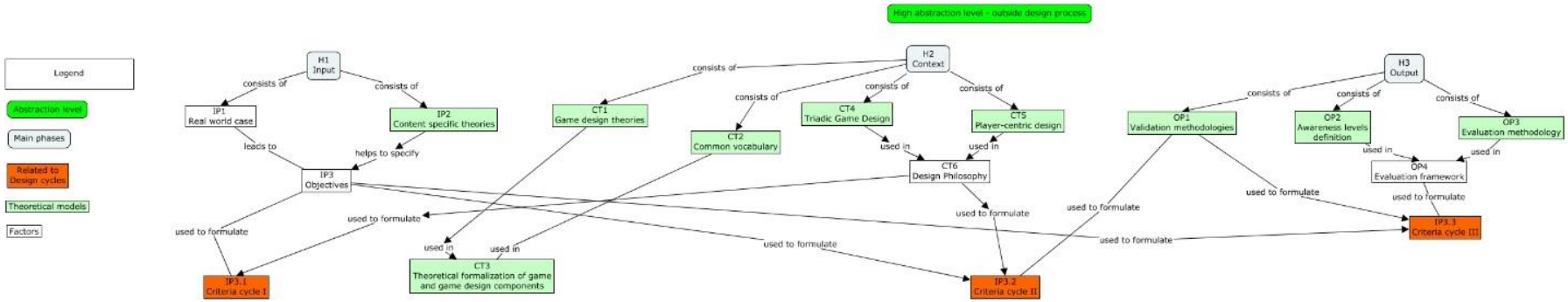

Figure 8 Depiction of the contextual level. The light green blocks denote theoretical models used within the framework. The orange blocks represent the interface with the procedural level

3.2.2. Contextual level

In section 2.1.2. we had identified the contextual level and divided it into the input, context and output as we show in Table 10. At the input side, we have the content specific theories. The content specific theories focus on attaining specific objectives. Those objectives are defined by the real world case at hand. In the previous section we had identified criteria at the interface between the contextual level and the procedural level. The objectives are naturally primary criteria for the design process to refer to.

Table 10 Overview of the contextual level of awareness game design literature.

Contextual (High) level			
Input	**Context**		**Output**
Objective focused - Content specific theories (Kiili et al., 2005, 2014; Bots & Van Daalen, 2007; Ibrahim & Jaafar, 2009; Aleven et al., 2010; Starks, 2014; Ahmad et al., 2015)	**Common vocabulary for design** (Hunicke et al., 2004; Amory, 2007; Westera et al., 2008)	**Triadic design perspectives** (Frank, 2007; Harteveld, 2008; Winn, 2009; Rooney et al., 2012)	**Evaluation & Validation** (De Freitas et al., 2006; Mitgusch & Alvarado, 2012; Warmelink et al., 2016; Serrano-Laguna et al., 2017)

At context side, we have the frameworks for a common vocabulary and the triadic design frameworks. These focus on communications surrounding game design and perspective on the design process as we have seen in section 2.1.1.

Looking at the results from section 2.2.3. in Table 7, we find that a number of merged categories from the entertainment game design literature relate to these aspects as well:

- Game design core concepts
- System/structure
- Common vocabulary

The game design core concepts primarily relate to how to approach game design. In addition to those merged categories, we further illustrate some of the lower level categories related to how to approach game design in Table 11.

Table 11 Lower level trees from entertainment game design literature analysis regarding game design approach

Adams & Rollings (2007)	**Salen & Zimmerman (2004)**
1) Design components and processes i) Player-centric design (a) Entertain (b) Empathize	1) Core concepts i) Meaningful play ii) Design (a) Context (b) Participant (c) Meaning iii) Interactivity (a) Modes (b) Designed interaction (c) Choices
Bateman & Boon (2006)	
1) Game design i) Philosophy (a) Zen game design 1. No single method 2. Design reflects needs	

From Table 7 and Table 11 we see that entertainment game industry approaches design primarily from the "play" side, with important categories such as player-centric design, entertain, empathize, meaningful play and interactivity. The entertainment game design approach differs from the triadic game design approaches, as it specifically focusses on the player experience. The entertainment game design perspective could play a role in strengthening the "play" related elements of the triadic game design approaches. We can group this in general terms as the game design philosophy. Depending on the game design philosophy of the designer, the criteria for the design process will differ.

Both the awareness game design literature and the entertainment game design literature call for a common vocabulary. The common vocabulary category from section 2.2.3. in Table 7 relates to the need for a common vocabulary (Salen & Zimmerman, 2004) and definitions (Schell, 2008). The system/structure category from section 2.2.3. in Table 7 provides a breakdown of games from different perspectives similar to those performed by Amory (2007), Hunicke et al. (2004) or Westera et al. (2008) from Table 10. For instance, Salen & Zimmerman (2004) use game design schemas to look at the structure of games and Fullerton (2008) breaks it down into elements, dynamics and interactive components as we can see in Table 12. Which of these to use will depend on the situation and perspective most suited to that situation.

Table 12 Lower level trees from entertainment game design literature analysis regarding game structure.

Fullerton (2004)	**Salen & Zimmerman (2004)**
1) System i) Elements (a) Objects (b) Properties (c) Behaviors (d) Relationships ii) Dynamics (a) Possibility space (b) Economies (c) Emergent iii) Interaction (a) Information structure (b) Control (c) Feedback	1) Game design schemas i) Rules (a) Logical structures (b) Mathematical structures ii) Play (a) Experiential (b) Social (c) Representational iii) Culture (a) Contextual

We can group them as a theoretical formalization of game design and game design components. We feel that it is difficult to connect them to the procedural-contextual level interface, as they do not really represent criteria. Rather provide a common vocabulary that can be used in formulating a concept and building the game.

3.2.2.3. Output

At the output side of the contextual level, we find from section 2.1.1. methodologies for validation and evaluation as we can see in Table 10. We did not find any relevant categories regarding validation or evaluation in the entertainment game design literature, since the primary objective of entertainment games is very different from those of awareness games. We added a category of "awareness levels" to the framework, that relates to the definition of awareness we presented in section 1.1. We believe that

it is important for the evaluation to be able to measure various levels of awareness. Simply measuring an increase in awareness is not sufficient to warrant the effectiveness of awareness games as opposed to other, less costly, options such as booklets or lectures.

3.2.3. Developmental level

In this section, we illustrate how the developmental level was constructed. In section 3.2.1. we mentioned that the products of the various design phases could be found at the procedural-developmental interface. We will determine what those products are and what steps are related in their development. We break it down into the three design stages we identified in section 3.2.1.

3.2.3.1. Concept stage – Design specifications, system model and concept report

In this section, we describe the formation of the products in the concept stage.

Design specifications

The design specifications (or design specs) are a product resulting from the specifications design phase. It does not feature in the entertainment game design industry. Duke & Geurts (2004) mention that it is an extension of the development of the problem statement. The design specifications should result in a pragmatic list of concerns for game designer to address during the entire development process of the game. The objective is to delineate the constraints and expectations for the project. The design specifications are developed in conjunction with the client, who determines the financial resources for the project. It is important that the client also signs off on the design specifications so it is clear what the goals and expectations are for the project.

Peters & Van de Westelaken (2014) mention two steps in developing the design specifications. The first step being the intake or client consultation, to collect information about the goals of the game and demands of the client. Furthermore, the subject of the game will be (provisionally) delineated. The second step is the specifications of the design, which requires several more meetings with the client to form a more accurate description of the game as it should be at the end of the project. This means formulating wishes and requirements of the client as precisely as possible.

Wenzler (1997) mentions the development of the design specifications as an interactive process with the client to answer a few sets of questions. It starts with a problem analysis trying to identify the problem background, identifying the boundaries of the problem environment and the main issues to address. There are questions regarding the objectives and expectations of the client for implementation. Then questions are asked to identify the boundaries of the game, participants of the game and the model of reality.

Taking the overlap between the various sources, we find that communication with the client, or client consultation, is key for developing the design specifications. Wenzler (1997) further mentions starting out with a problem analysis. The objective of the design specs is ultimately to precisely define, together with the client, the problem, goals, expectations and constraints of the project. The design specs will be used to further guide the development of the project. We illustrate these steps in Figure 9.

System model

The system model is a product linked to the system analysis design phase. As with the design specifications, the system model is not a product that is featured in entertainment game design. The main

purpose of this step is to investigate the underlying nature of the problem (Duke & Geurts, 2004). Duke & Geurts (2004) mention that it is essential to get a gestalt perspective of the problem as reflected in the mental models of the various stakeholders. Thus, interviews are to be conducted with the major stakeholders for their perception of the problem. As much information about the system and elements as possible should be collected to identify the problem environment. The findings are then captured in a model: identify the major actors, goals, activities resources and interactions between them. The boundaries, actors, inputs and outputs of the problem will be uncovered.

Peters & Van de Westelaken (2014) highlight that the purpose of the system model is to produce a detailed description of the problem context that provide guidance for the next steps in design process. They use an actor analysis as a starting point, although mention that it is not the only approach possible. As with Duke & Geurts (2004), they recommend to collect as many loose elements regarding the problem environment as possible (e.g. interviews with key informants, literature study) and then establishing the relationships between them. This eventually results in a visual representation of the problem environment.

Wenzler (1997) mentions that the first step is the identification and creation of knowledge relevant to problem environment. Then an actor analysis is conducted of the main actors in that environment. Following the actor analysis, the main relations of actors, processes within those relationships and flows within those processes are identified. This leads to the development of a "road map" through the problem environment.

We see that all the sources mention the need for collecting as much information as possible from key stakeholders. A general starting point is the actor analysis. After this it is important to identify the relationships between the actors and any other elements related to the problem environment.

Concept report

The concept report is a product related to the concept design phase. Duke & Geurts (2004) describe that the purpose of the concept report is to document design agreements that will govern the game, consolidate ideas into a workable blueprint, obtain client sign-off. The report should describe the initial specifications of the game (e.g. problem environment, participants, proposed method of the game presentation), as well as an outline of the procedures for construction of the game (e.g. game components, data to be used, order of processing sequence in game). Generating ideas for the development of the concept report is where much of the artistry of game design comes into play (Duke & Geurts, 2004). Peters & Van de Westelaken (2014) and Wenzler (1997) describe the same guideline as in Table 4 in section 2.1.1. to do so, which involves selecting elements of the system model, followed by a more creative exercise to develop game elements. In the entertainment game literature we also find a wealth of categories on developing a concept as we show below in Table 13.

Table 13 Lower level trees from entertainment game design analysis regarding design concept.

Adams & Rollings (2007)

1) Design components and processes
    i) Design stages
        (a) Concept stage
            1. Concept
            2. Audience
            3. Progression
            4. Player role
            5. Fulfilling dream

Bateman & Boon (2008)

1) Foundation
    i) Phases
        (a) Concept
            1. Developer-Publisher relation
            2. Ideas
            3. Concept document

Rollings & Morris (2007)

1) First concept
    i) Skills
        (a) Creativity
        (b) Craft
        (c) Technique
    ii) Stages
        (a) Idea generation
        (b) Written treatment
        (c) Taking stock
            1. Analysis
            2. Evaluation
            3. Justification
    iii) Creative process
        (a) Inspiration
            1. Originality
            2. Everywhere
        (b) Synthesis
            1. Pick & Mix
        (c) Resonance
            1. Synergy
            2. Theme
        (d) Convergence
            1. Critical judgment
    iv) Idea shaping
        (a) Dramatic effect
            1. Style
            2. Plot
            3. Character
            4. Setting
            5. Theme

Schuytema (2007)

1) Game design
    i) Process
        (a) Core concept
            1. High concept
            2. Main principles
            3. Major features
    ii) Development cycles
        (a) Pre-production
            1. Concept
            2. Brainstorming
            3. Evaluation of competitors
            4. Getting resources
            5. Design documents

Fullerton (2004)

1) Designing games
    i) Conceptualization
        (a) Ideas
            1. Creativity
            2. Analysis
            3. Brainstorming
            4. Alternate methods
        (b) Editing and refining
            1. Technical feasibility
            2. Market opportunity
            3. Artistic considerations
            4. Cost restrictions

From Table 13 we can see that in the entertainment game design literature a multitude of different ideas across the literature can be found. A recurring theme is the creative process for generating different ideas for the concept. For example, Fullerton (2008) mentions brainstorming, idea cards, list creation and mind maps as potential methods. Rollings & Morris (2007) use a strategy of "pick & mix" and try to filter ideas by their synergy and relation to an overlapping theme. Each of the sources have a different way of approaching this process. Since it is a creative process, we feel that there is not necessarily one "best practice" to follow. It will be up to the designer's preference which of the approaches will suit best. We thus left the first step of idea generation rather ambiguous on purpose and refer to any of the sources to find inspiration to generate ideas.

We further identify two common elements between the entertainment game design literature and the awareness game design literature, which we categorize as follows:

- The core concept – this relates to the initial specifications of the game as will have to be agreed upon with the client. Duke & Geurts (2004) mention several aspects. Fullerton (2008) adds to that with taking into account technical, economic and artistic considerations. Bateman & Boon (2008) mention the developer-publisher relation to be considered.
- The core mechanics – this relates to those elements that will govern the core of how the game function and around which the other game elements are developed.

We illustrate this in Figure 9.

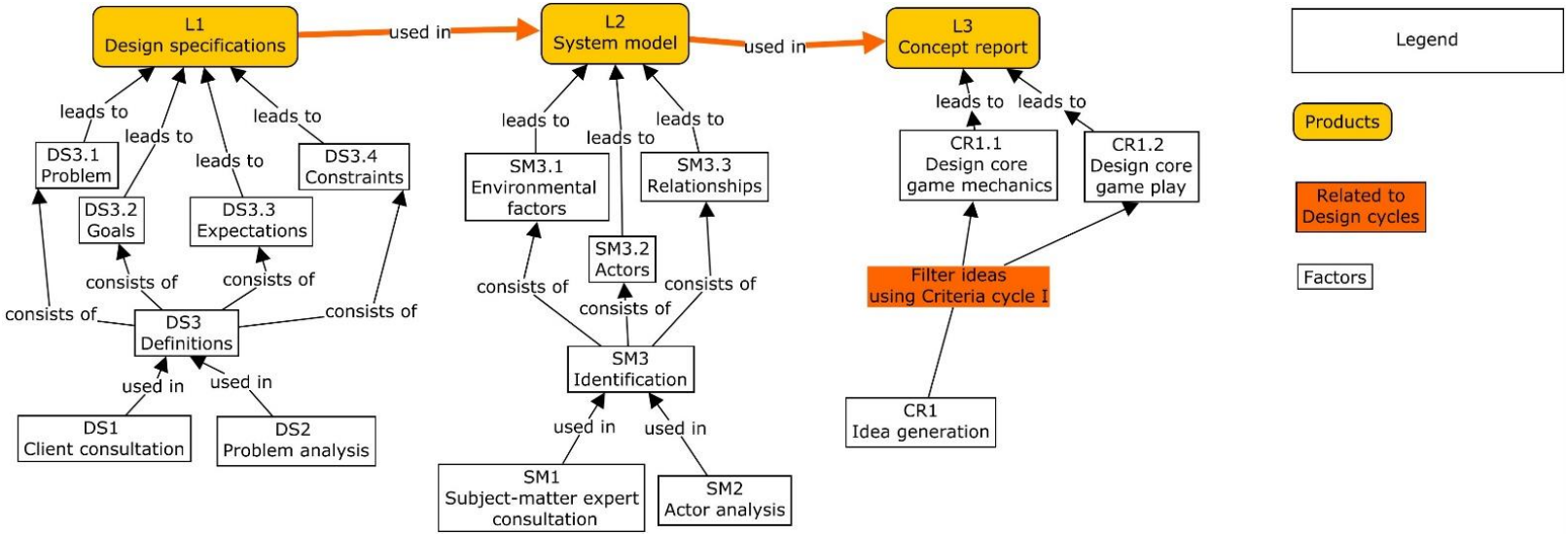

Figure 9 Factors contributing to the development of design specifications, system model and concept report.

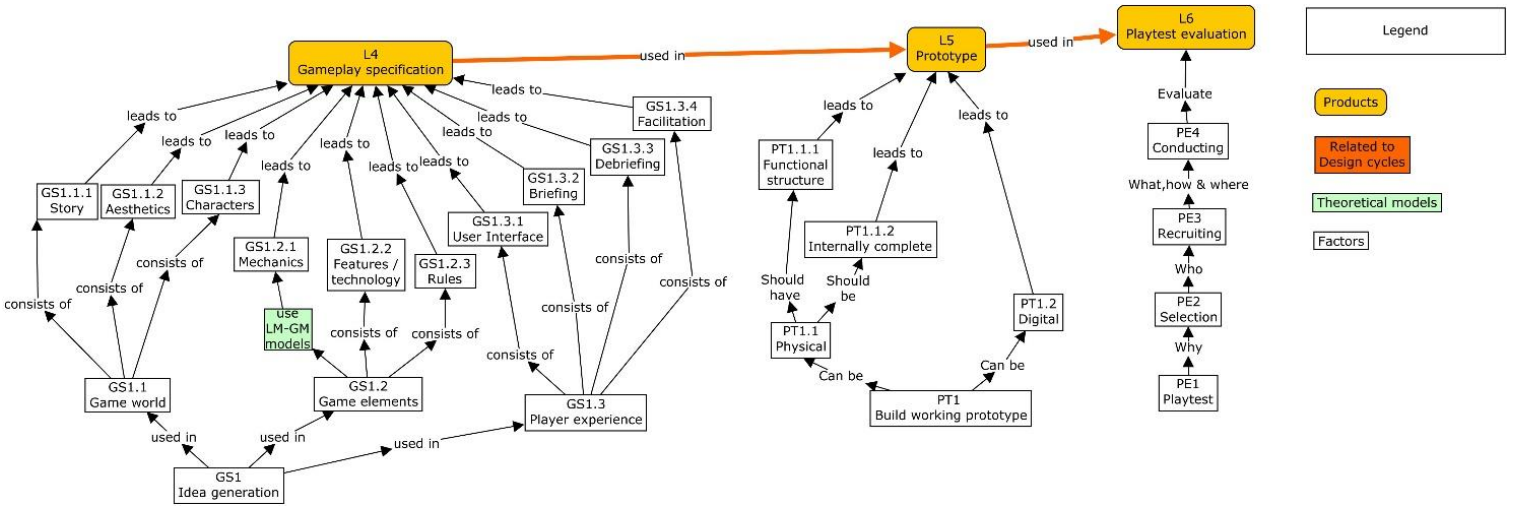

Figure 10 Factors contributing to the development of gameplay specifications, prototype and playtest evaluation.

3.2.3.2. Production stage - Gameplay specification, Prototype and Playtest evaluation

In this section, we look at the products in the production stage.

Gameplay specification

The gameplay specification is the product related to the building/prototyping design phase. It is a document detailing everything about the game artifact. There may be many ways to describe the game artifact as we have already seen in section 2.1.1. with various frameworks on game design nuclei (Hunicke et al., 2004; Amory, 2007; Westera et al., 2008). To be consistent with our approach so far, we looked at our analysis of the entertainment game design literature. We find several of the merged categories from Table 7 from section 2.2.2. that we relate to the gameplay specification. We illustrate this below in Table 14.

Table 14 Merged categories from section 2.2.2. related to the gameplay specification.

1. Game elements		
Adams & Rollings (2007)	Fullerton (2008)	Schell (2008)
Play	Players	Mechanics
Pretending	Objectives	Story
Goal	Procedures	Aesthetics
Rules	Rules	Technology
	Resources	
	Conflict	
	Boundaries	
	Outcome	

2. Player experience	
Bateman & Boon (2006)	Schuytema (2007)
Audience	Perception
Demographic	Emotions
Player typology	Challenge
Demographic Game Design 1 model	User Interface
Player abilities	Environment design
	Conflict design
	Game flow design
	Storytelling

3. Game world	
Bateman & Boon (2006)	Rollings & Morris (2007)
Components	Ambience
Motivations for abstraction	Interface
Abstractions	Storytelling

We find that these categories can be compatible with the MDA framework by Hunicke et al. (2004) as we highlight below.

- Game world - Bateman & Boon (2006) talk about the game world as an abstraction of reality. The "look and feel" of it is determined by the ambience, interface and storytelling (Rollings & Morris, 2007). We feel that the concept of a game world fits well with Aesthetics as Hunicke et al. (2004) describe. They use a vocabulary of concepts such as fantasy, narrative, discovery to define the aesthetics of the game. Or as they view it, the components that make the game fun, from the player perspective.
- Game elements – We find several different breakdowns for game elements by Adams & Rollings (2007), Fullerton (2008) and Schell (2008). In the MDA framework, the mechanics and dynamics are the underlying components of the game that govern how the game works to provide experiences to the player. The game elements of play, pretending and goal by Adams & Rollings (2007) are omitted from this perspective as they view it more from a player perspective. The game elements listed by Fullerton (2008) overlap with the game mechanics as Schell (2008) mention. Story and Aesthetics as mentioned by Schell (2008) already feature in the "game world" as we have defined. This leaves us with mechanics, technology and rules as overarching categories. For choosing game mechanics we can make use of the LM-GM models (Suttie et al., 2012; Kelle et al., 2011; Arnab et al., 2015) we had identified in section 2.1.1.
- Player experience – We find that there is a lot of overlap with the game world as we defined earlier, as a focus on player experience in the entertainment game industry generally focusses on the "fun" aspects. However, this prompted to think of other factors that influence the player experience, unrelated to fun. From the entertainment game design side we feel that user interface design falls under this category. One could argue that it might also be placed under game world, as it could influence the "fun" aspect in a negative manner if the user interface is done badly. For awareness games Duke & Geurts (2004), Wenzler (1997) and Peters & Van de Westelaken (2014) mention the importance of briefing, debriefing and facilitation of how the game is eventually experienced.

We illustrate this in Figure 10.

Prototype

The next product to develop is a working prototype. Regarding the prototype, we find the following lower level categories as shown in Table 15. The amount of detail we gathered surrounding prototyping is rather limited, because this step is mostly related to actual game development, which was filtered as it falls outside the scope of this thesis as we mentioned in section 2.2.1. In terms of conceptual design, Fullerton (2008) and Schell (2008) at least mention that a major consideration when building a digital game is whether to first develop a physical prototype or a digital one. In general it is much faster and easier to develop a physical prototype than a digital one. Those authors recommend to start with building physical prototypes to settle the core gameplay before continuing to build a digital prototype. Fullerton (2008) mention that for such "quick and easy" prototypes they should at least have the functional structure and they should be internally complete.

Table 15 Lower level trees in entertainment game design literature analysis regarding prototype.

Fullerton (2004)	Schell (2008)
1) Formalization 2) Methods i) Physical (a) Foundation 1. Fun (b) Structure 1. Functional (c) Formal details 1. Functional 2. Internally complete 3. Balance ii) Digital (a) Types (b) Control scheme (c) View points (d) Interface design (e) Tools	1) Prototype i) Answers a question ii) Forget quality iii) No attachment iv) Prioritize v) Parallelize vi) Paper-based vii) Fast-loop engine viii) Build toy first

Playtest evaluation

After prototyping the playtest evaluation is conducted. Regarding playtest evaluation we find the following lower level categories as shown in Table 16. For conducting playtests, Fullerton (2008) and Schell (2008) provide several considerations to make before starting a session. These were merged into procedural steps of: (1) why is a playtest conducted - selecting what the designer wants to learn from it; (2) who should be playtesting - recruiting people ranging from the developers themselves in initial stages to the target audience in the later stages; (3) what is playtested (e.g. list of questions), where is the playtest taking place (e.g. studio, target location), how is the playtest done (e.g. briefing, data collection) - all the details of conducting the playtest itself.

Table 16 Lower level trees in entertainment game design literature analysis regarding prototype.

Schell (2008)	**Fullerton (2004)**
1) Playtesting i) Why - playtest to answer a question ii) Who (a) Developers (b) Friends (c) Experts (d) Tissue tester iii) Where (a) Studio (b) Playtest lab (c) Public (d) Target location (e) Online iv) What (a) List of questions (b) Surprises v) How (a) To be or not at playtest session (b) What information to give (c) Look at faces (d) Data collection	1) Goal i) Player experience 2) Process i) Selection ii) Recruiting iii) Conducting
	Bateman & Boon (2008)
	1) Foundation i) Phases (a) Concept 1. Developer-Publisher relation 2. Ideas 3. Concept document

3.2.3.3. Balancing

Balancing is an important part of the design process and features in many of the literature sources we examined as we will see below. The balancing design phase also does not really have a "product" as such. Balancing ideas are used to adjust prototype and thus the eventual gameplay specifications.

From the analysis on the awareness game design literature in section 2.1.2., we find that the triadic design perspectives deal with balancing issues. Of these frameworks, Harteveld's (2011) framework provides specific criteria that we can use as a starting point, which is shown in Table 17.

Table 17 Balancing criteria for triadic game design framework by Harteveld (2011).

Play	Meaning	Reality
Immersion	Motivation	Validity
Engagement	Transfer	Flexibility
Fun	Relevance	Fidelity

For the play side we could refer to the entertainment game design literature. The final merged category from section 2.2.2. that we have not yet incorporated of engagement and entertaining elements relates to this. This and further additional factors regarding balancing are also presented below in Table 18.

Table 18 Lower level trees from entertainment game design literature regarding balancing.

Adams & Rollings (2007)	**Schuytema (2007)**
1) Entertain i) Gameplay ii) Aesthetics iii) Harmony iv) Storytelling v) Risks and Rewards vi) Novelty vii) Learning viii) Creative and expressive play ix) Socializing x) Immersion (a) Tactical immersion (b) Strategic immersion (c) Narrative immersion 2) Design components and processes i) Balancing (a) Meaningful choices (b) Chance (c) Fairness (d) Comeback mechanism (e) Managing difficulty 1. Skill 2. Stress 3. Flow	1) Concept of fun i) Receptiveness ii) Expectations iii) Subjective likes iv) Ingredient X (a) Surprise (b) Coincidence (c) Flash of genius (d) Extreme emotion (e) Transientness (f) Shattered 2) Player experience i) Perception (a) Immersive perception 1. Imagination 2. Player understanding of game world 3. Difference real world
Fullerton (2004)	**Schell (2008)**
1) Engagement/Dramatic elements i) Challenge (a) Skill (b) Flow (c) Clear goals (d) Feedback (e) Paradox of control ii) Play iii) Premise (a) Playability (b) Emotional appeal iv) Character v) Story vi) World building vii) Dramatic arc	1) Balance i) Fairness ii) Challenge iii) Meaningful choices iv) Skill vs Chance v) Mental vs Physical vi) Competition vs cooperation vii) Short vs long viii) Rewards ix) Punishment x) Freedom vs control xi) Simple vs complex xii) Detail vs imagination

Balancing is a complex process that requires many different factors to be balanced as we can see for instance from Adams & Rollings (2007) and Schell (2008) in Table 18. From the entertainment game design literature, balancing is done to generate the most fun experience for the player. For awareness games this is obviously not the only factor, as the triadic design frameworks we analysed in section 2.1.1. highlight. We thus rather chose to use the criteria in Table 17 and use the lower level trees from Table 18 to complement these criteria.

We found that it is difficult to categorize the lower level trees from Table 18, without making the structure overly complicated and blown up. For instance, categories such as gameplay, playability and meaningful choice could have an impact on all three of the criteria of fun, engagement and immersion. Instead of trying to link all possible levers for balancing to the various criteria, we have picked out a number of categories that we ourselves deemed to be the most important and chose to structure them as shown in Table 19. We feel that an even more complicated structure would not benefit the designer at all. These balancing categories serve as inspiration for the designer to think of, rather than a comprehensive list of balancing levers. This is also what the original literature also mentions.

Table 19 Structuring of categories related to fun, engagement and immersion.

Fun	**Engagement**	**Immersion**
Fairness	Emotional appeal	Tactical
Rewards/punishments	Fantasy	Strategic
Meaningful choice	Curiosity	Narrative
Progress	Aesthetics	Flow
Surprise	Gameplay	Difficulty
	Playability	Skill
	Feeling of control	Challenge
	Flow	Story
		Game world

Regarding the meaning criteria of transfer and relevance, we did not find any complementary categories from the entertainment game literature. We found it most relevant to refer back to the objective focused models we analyzed in section 2.1.1. In case of the framework, this is reflected in criteria cycle 1 (concept stage). In relation to motivation, we found Maslow's hierarchy of needs mentioned by Schell (2008).

For the reality criteria we also did not find any complementary categories from the entertainment game literature. Regarding "fidelity", we also refer back to looking at the criteria in cycle 1 (concept stage). As this is where the specifications and the system model are developed in order to relate to the adequate representation of the problem environment. Regarding of "validity", we found in section 2.1.1. that Warmelink et al. (2016) provide several tools for improvement. Regarding "flexibility", Harteveld (2011) mentions the possibility for modular game building.

We summarize these findings in Figure 12.

3.2.3.4. Implementation stage - Completed product, Briefing and facilitation document, Debriefing document

In this section, we discuss the products of the implementation stage as seen in Figure 11. Unsurprisingly we did not find any related categories in the entertainment game literature, as this stage does not feature for entertainment games. Not many specifics are provided by Duke & Geurts (2004), Peters & Van de Westelaken (2014) and Wenzler (1997) either. One explanation may be that these documents are very dependent on the project and it is thus very hard to give any generic guidance on their development. However, this prompts that additional research should be done to find factors to guide the development process of these products.



Figure 11 Products in the implementation stage of the design process

3.2.4. Combining the levels into an integrated framework

In the sections above we have identified the components making up the procedural level, the conceptual level and the developmental level, as well as the interfaces between them. Combining them brings us to develop an integrated design framework (see Figure 13).

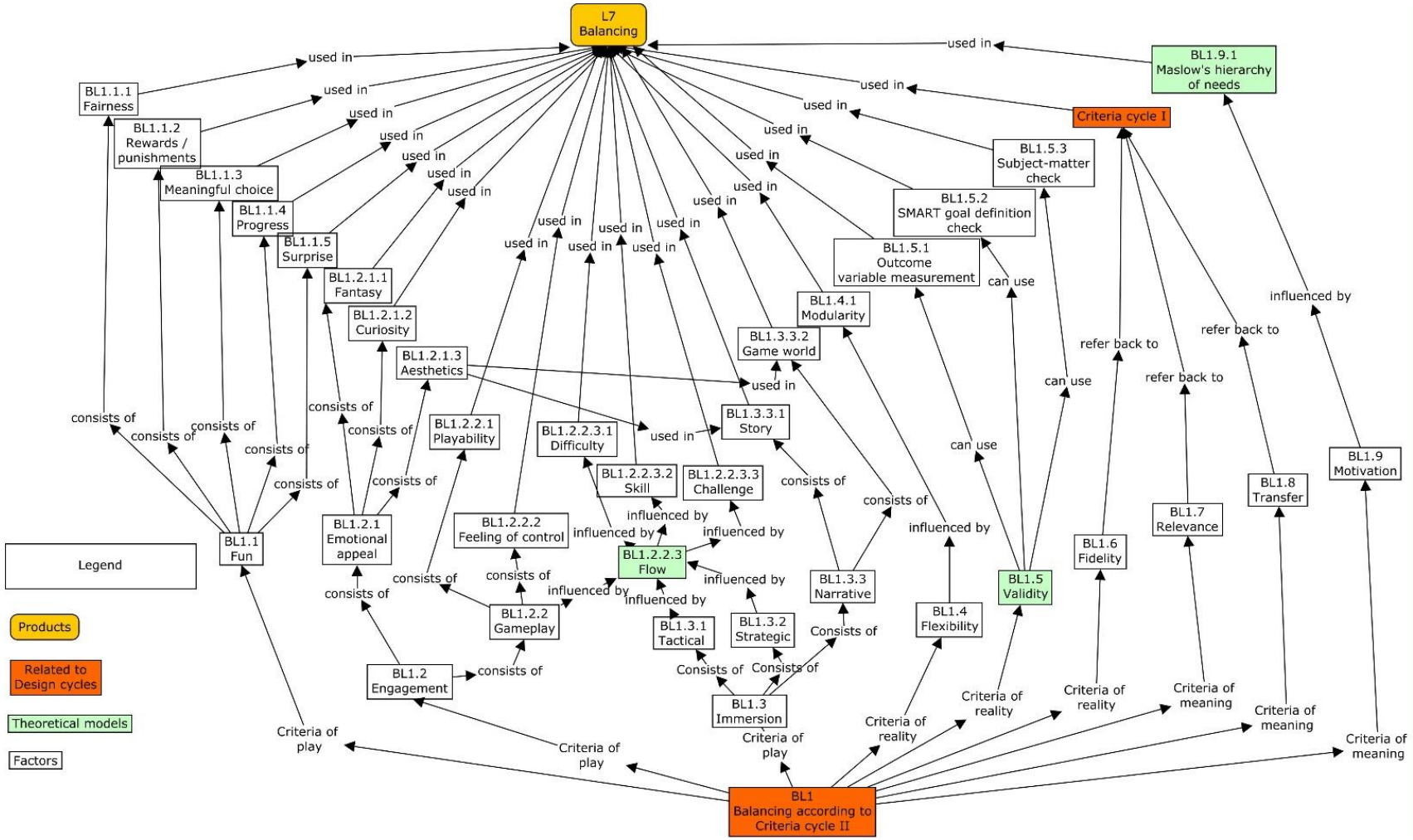

Figure 12 Factors that contribute to balancing, based on criteria from the triadic design frameworks as analyzed in section 2.1.1.

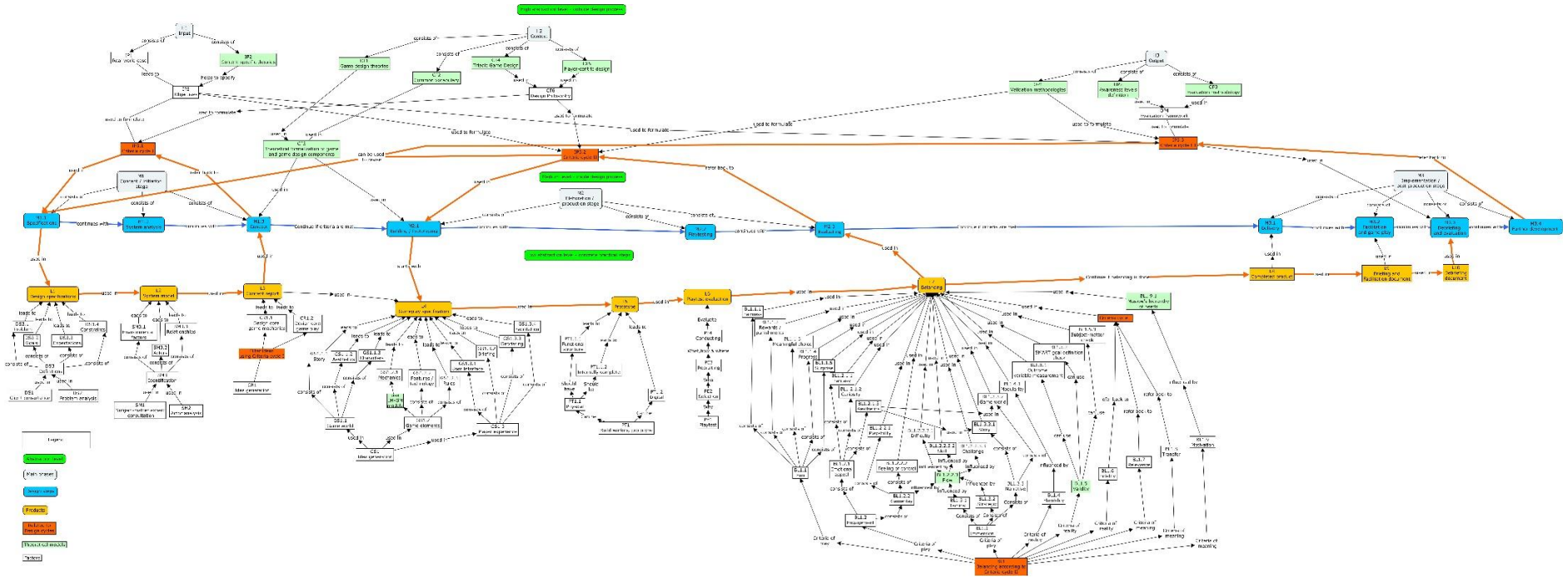

Figure 13 Design framework after integrating the contextual, procedural and developmental levels.

3.3. Limitations of the design process

Here we discuss some of the limitations of the design process:

- The process of the methodology did not follow the full set of systematic procedures from grounded theory and this may diminish the validity of the process.
- The methodology is heavily reliant on the interpretation of the researcher: in determining what information is relevant for awareness game design; in choosing definitions for the codes; and determining which codes are similar enough to merge.
- The connections drawn between concepts may not fit with the original context or use of the concept.
- The literature search we conducted did not cover all areas, as we can see a clear gap in the implementation stage. There were also a limited amount of frameworks that relate specifically to awareness games. Therefore we had drawn from frameworks from adjacent fields, such as educational game design frameworks.

To mitigate some of these issues we have discussed the design process with a game design expert.

3.3.1. Interview with game design expert regarding development of the framework

After developing the framework, we discussed the development process with a game design expert, Ir. S. A. Tiemersma, head of the Delft University of Technology Gamelab. The purpose of the discussion was to check our coding process from section 2.2. and development of the framework. We explained the coding schematic to the game design expert as we developed in section 2.2.1. We illustrated it by means of a sample from the coding process by showing how Rollings & Morris (2007) and Bateman & Boon (2006) was coded. After this, we illustrated how this led to the merged concepts formed in Table 7 and how these were integrated into the design framework. We then asked the following open-ended questions:

Question 1. Was the coding process to extract information from the game design literature done correctly or did we miss important concepts by performing it this way?

Question 2. Were the choices for merging the concepts logical or did we incorrectly judge the similarities between certain concepts?

Question 3. Do the connections between the concepts make sense or did we make an error in linking certain concepts?

Coding process

The interviewee was familiar with the entertainment game design literature we presented, as he had studied them extensively as well for his own research project in the past. In general, the coding process itself was deemed to be executed well, but there were a number of sidenotes mentioned.

> *"I think the coding process is well done and is an important step in the development of the framework. The steps seem to be executed just fine. In practical terms, it may have been more condensed and insightful if you used visualizations of the concepts instead of words."*

A suggestion for improvement was made to use visualizations to depict the concepts in the various sources. This may help to condense the number of categories. It is also taken in relation with the observation that different game designers use a different terminology, which will be less of an issue when the concepts are visualized.

> *"The thing with these books on game design is that everyone uses a different terminology. Sometimes they invent new terms, sometimes they use the same terms, but in different contexts. It is not really formalized that way. You run a risk when using the same terms from different sources."*

The potential different uses of terminology also has impact on how certain concepts might be merged. The expert notes that we took into account that different terms could be used for the same or similar concepts, but our methodology did not account for terms being used differently. Another point that was mentioned is that the overarching design philosophy or view from which the game design literature was written is not captured by the coding process.

> *"Game design has an art element in it, at least for some elements more than others, that require experience or some sort of feeling. That is design knowledge that is not obtained in a scientific way, but requires playing and designing games…. These books are written by those authors with some kind of philosophy or view on game design they have accrued over years of experience. By translating these books into abstract concepts you won't be able to capture this overarching philosophy or vision."*

Constructing the framework

Regarding the construction process of the framework, the content of the elements were done correctly. However, in practical terms there could have been better condensing of the concepts, before being put into the framework. Not all elements fit the practical category and adding those makes the framework extra complex without adding much value.

> *"It is very difficult to add these concepts to such a framework. Many of these elements do not really fit in the kind of practical category of 'now I should think of balancing, or now I should do this'. To be a good game designer, you should study all these elements and have this as 'readily available knowledge'. This is not necessarily true for everything, but that is what makes it difficult to decide what to put in. I think content-wise what you have done is correct, however, from a more practical perspective it should probably be even further condensed before putting it into the framework"*

An improvement would be to empirically test which elements should be present in the framework with game designers, or interviewing additional game design experts. In the next Chapter, we shall deal with the latter of the two.

> *"You should find out, which of these components are essential in the design process. Perhaps by means of practical testing in a game jam, which is a sort of week-long workshop in which teams of people have to make a game. Or by interviewing additional game design experts. "*

To conclude, the coding process was done correctly in general, but may have incorrectly merged terms that are used differently across the literature. Also, the overarching philosophy or vision was missed. The construction process was done correctly as well content-wise, but could have had a more practical perspective.

Chapter 4: Evaluation of design framework

In this Chapter we evaluate the design framework for awareness games we have developed in Chapter 3, using two different methods. Firstly, we have consulted experts on game design to provide feedback on the design framework. Additionally, an empirical case in which the author designed an awareness game is analyzed to see whether application of the framework would potentially have been able to improve the game design process. We analyze the main issues during the design process and evaluate whether using the design framework would help to resolve them.

4.1. Game design expert evaluation

In this section, we deal with the game design expert evaluation of the framework. We start with explaining how we asked for feedback from the experts. Then we present the selection of game design experts that were asked for feedback. The results of that feedback is then presented in the form of quotes. Finally, we summarize the findings and reflect on what the feedback by experts means for.

4.1.1. Feedback design

The aim of the feedback is to evaluate to what extent the developed framework meets the research objective and thus how useful it would be in providing more practical guidance for designers of awareness games. We have consulted ten experts in game design to give feedback, as well as provide insight on how to improve it. They were provided with an introduction on the background of the framework, an explanation of how the framework was developed and built up, and the theoretical basis for underlying the framework. Each of the experts were asked a list of open-ended questions:

Question 1. Clarity – Was the framework understandable? If not, what parts were unclear?

This question was asked due to the complexity of the framework and the many factors involved in it. The question was meant to clarify whether the expert sufficiently understood the framework or that any further explanation was required.

Question 2. Content – What parts of the framework do you agree/disagree with? Are there any factors or relations missing?

This question was asked to have the game design experts examine the validity of the content of the framework regarding the factors and relations that make up the framework.

Question 3. Usefulness – Do you think the framework is useful in providing practical guidance for designers of awareness games?

This question was asked to evaluate the usefulness of framework in relation to research objective of providing practical guidance for designers of awareness games.

Question 4. Usability – Do you think the framework is usable in this form? Do you have suggestions to improve its usability?

This question was asked to examine the usability of the framework, also in relation to the research objective of providing practical guidance for designers of awareness games. Additionally, we asked their expertise for suggestions on how to improve it.

Question 5. Additional feedback – Do you have any other comments?

This question was asked to extract additional feedback based on expert background in game design or other experiences.

The feedback has been documented or recorded, depending on the communication mode the experts preferred. After the feedback had been processed, we send it back to the game design experts for confirmation on whether their feedback had been correctly processed.

4.1.2. Game design expert selection

The game design experts that were consulted were chosen to represent a mix of experts from practice as well as academia. Where possible we have tried to include experts working at different geographical locations as well, in order to better represent different communities.

Table 20 List of consulted game design experts and respective backgrounds

	Experts	Background
E1	Dr. Ir. G. Bekebrede	Dr.ir. G. Bekebrede is an assistant professor at the Faculty of Technology, Policy and Management of Delft University of Technology. Her PhD research in 2010 was about the use of serious gaming for understanding complex infrastructure projects. Currently her research topic involves the use of gaming in education and policy making, related to complex decision making processes. She was involved in a large number of game design projects and several evaluation projects of the effects of gaming.
E2	Ir. S. A. Tiemersma	Ir. S. A. Tiemersma is a project leader and game designer at the Delft University of Technology GameLab. The Gamelab cooperates with researchers, PhD candidates, students and often external partners to develop simulation games, simulations, and game systems with a research objective.
E3	Dr. H.K. Lukosch	Dr. H.K. Lukosch is an assistant professor at the Faculty of Technology, Policy and Management of Delft University of Technology with a background in social and media sciences. Heide explores the design and effects of interactive visualization techniques like simulation games. Amongst others, she has co-developed virtual environments for team training of police teams, and games for further technical education. Heide's research aims at supporting actors in complex situations to develop situational awareness in order to increase their performance.
E4	Dr. E. Leigh	Dr. E. Leigh is a senior lecturer at University of Technology Sydney. Her work involves research on using Simulation and Games for learning. She is also the Director and Creative Designer of FutureSearch, an educational consultancy based in Sydney specialising in creation and management of high energy learning environments using simulations and games.
E5	Dr. H.Warmelink	Dr. Harald Warmelink is a senior researcher at the Academy for Digital Entertainment, NHTV Breda University of Applied Sciences, the Netherlands. His research projects and resulting publications are on the intersection of game studies and organization studies. He is particularly focused on the design, use and evaluation of serious games for policy analysis, decision-making, management and organization, as well as their gamification. He obtained his PhD degree at Delft University of Technology (Faculty of Technology, Policy and Management) in 2013 with the thesis 'Towards Playful Organizations', for which he won the German Simulation and Gaming Award in 2015. He is the author of

		the book Online Gaming and Playful Organization (2014, Routledge) and has published in journals such as British Journal of Educational Technology, Journal of Gaming and Virtual Worlds, Simulation and Gaming, and Organization Studies.
E6	D. Groen	D. Groen is the Creative Director, Game Designer and co-founder of InThere. InThere is a company specialized in the development of MicroGames: short, powerful Serious Games. They build custom Microgames to fully integrate them within the client's organization. Their goal is to make the technique of Serious Gaming tangible, scalable and affordable. They primarily focus on the learning objective and aim at the core of the problem.
E7	Dr. I. Wenzler	Dr. I. Wenzler is a Senior Principal at Accenture's Strategy organization and an Associate Professor at the Delft University of Technology. He holds a PhD in Simulations and Gaming from the University of Michigan. Before, he was the Head of Policy Analysis Group at the Radboud University in Nijmegen and Research Associate at the University of Michigan. At Accenture he uses simulation and serious gaming approaches aimed at helping his clients deal with their business transformation challenges. At the Delft University of Technology he teaches a master's course in simulation and serious game design.
E8	Prof. Dr.Ir. S. Meijer	Prof. Dr.Ir. S. Meijer is a full professor at KTH Royal Institute of Technology and a part-time associate professor at Delft University of Technology. He is specialised in gaming simulation and other interactive methods to involve the operational level of organizations in innovation processes. He also leads GaPSlabs: a multi-disciplinary center for gaming and participatory simulation in complex systems like transport, logistics, health care, urban development and energy. He uses gaming simulation for hypothesis testing, studying behaviour, knowledge and cognition, and designing new practices and procedures. Validity aspects of this type of research are his special interest, as well as multi-method simulation.
E9	Dr. C. Harteveld	Dr. C. Harteveld is an Assistant Professor of Game Design at Northeastern University. His research focuses on using games to study and improve decision-making. He uses these efforts to advance our knowledge and to engage a broad cross-section of people globally about societal issues. He applies games especially in areas where it is challenging to study and educate in natural environments as well as collecting detailed behavioral data in a controlled manner. Dr. Harteveld has worked across different disciplines to design and evaluate games on flooding, urban heat islands, debris collection, and pro se litigants.
E10	Dr. V. Peters	Dr. V. Peters has worked as an associate professor at the Radboud University and the HAN for over 25 years. His work involved the application of participative research methods. Within his research on those methods he focused on gaming simulations and management games in various applications: educating students, research on strengths and limitations of games and simulations, and building games and simulations for clients from different organizations and institutions. In 2005 he started the company Samenspraakadvies to focus on the application of gaming and simulations in practice.

4.1.3. Results of the game design expert feedback

The questions that were asked to the experts were open-ended in nature. In order to analyze their feedback, we structure the feedback by grouping it into several categories: (1) more fundamental feedback regarding the usefulness and usability of the framework, and the use game design frameworks in general; (2) feedback regarding the structure of the framework, such as the three levels in the framework as well as the interrelations between factors; (3) feedback regarding the content of the framework, such as the adaptation, addition or removal of factors in the framework; (4) additional suggestions or comments. We use quotes by the experts to highlight the various feedback. The quotes highlight all the points that the experts have mentioned with regard to specific topics surrounding the framework. Regarding the topics that are addressed, except what was quoted, no other additions or remarks had been made by other experts. Apart from quotes from E4, these quotes have been translated from Dutch to English.

4.1.3.1. Fundamental – usefulness and usability of the design framework and frameworks in general

We start with the fundamental feedback regarding the framework, the strengths and criticisms on the framework as well as the use of a framework in general.

4.1.3.1.1. Strengths of the framework

In this section, we mention the strengths of the frameworks as discussed by the experts.

The first two quotes mention the uniqueness of the framework, as well as the core structure of Duke & Geurts (2004), providing a good basis. Many of the details of game design are included, while remaining a cohesive framework. Less experienced designers will benefit from the additional detail to the steps by Duke & Geurts (2004).

> *"It immediately struck me as useful, as I have not seen something this detailed that is still cohesive, with the three levels combined with various game elements. It's good that you use Duke & Geurts as basis, since as far as I know it is the best one to use for games complex systems. Although I don't think there is anyone who designs games who strictly follows all the design steps. However less experienced people will definitely benefit from this (the framework). Students in the game design course are taught the steps (by Duke & Geurts), but it is difficult to make the translation to what has to be done within a step. I think having that level of detail is indeed very useful." [E3]* *(Q 1)*

> *"It's definitely useful to develop, as far as I know, such a thing does not exist yet. The core structure seems to be correct and very similar to design processes in other design domains, such as architecture and industrial design." [E2]* *(Q 2)*

The practical perspective, as opposed to the high level literature that we set out with in Chapter 1, is strengthened below.

> *"Good framework, I think it's very well-constructed. I think it's very useful, if it gets a practical application. Currently, it's a little cowboy, everyone uses their own methods. Most literature is really high level, which can be very insightful but indeed misses some practical application. It's very difficult to determine (from literature) how to design games. In companies, usually the first cycle can be a lot better. The second one is usually done well. But the third one is generally missing and it is good to mention explicitly to think about how to validate the game. If you manage to further refine it, it will be very valuable for game designers, also for me as a check to see if I considered everything." [E6]* *(Q 3)*

Once further refined, the framework may also serve as a check. Which is also mentioned in the next quote.

"In practice it can happen that a person becomes fixated on one component of the design process. In that case I can imagine it might be helpful to have such a framework as a check." [E8] (Q 4)

The framework also provides an overview going beyond most design literature and is useful in terms of concepts and ideas that are presented in it.

"I think it can be very useful for a lot of different people, in terms of ideas at the very least. Purely the picture is filled with concepts that contain a world behind it, for which people should read up on in your thesis or other literature. It is useful to have an overview that goes beyond most design literature." [E5] (Q 5)

It helps to generate awareness of the steps and factors in the game design process and the consequences of design choices. The idea that there is a higher level to consider and more detailed steps to take is of itself useful to be familiar with.

"It helps people to become aware of the steps and factors (within the game design process). Even though in practice things may turn out differently, whether consciously or unconsciously, it will help in designing a game through listing those things that will feature (during the game design process). Similar to Triadic Game Design, it makes you more aware of certain consequences of design choices. In this case you have certain steps you should follow, there is a higher abstraction level to consider in my design and there are more detailed steps to take (at the lower level). In and of itself, that is already useful for people to become familiar with. In practice you would not think of it this way, so it is useful to at least have seen the idea." [E9] (Q 6)

Depending on how the framework is viewed, different uses can be found such as: a guideline, when combined with additional guiding text;

"It's definitely useful, although it's currently just a first version. If you have some paragraphs for each section, it would definitely help. The framework serves as a picture and together with the text you have some sort of cookbook." [E9] (Q 7)

generating useful ideas;

"The hardest part is the translation from having a system model and a problem statement to figuring out how to make a game out of it, which is still fun to play. I would think the framework would help in doing so by showing the different (game) elements that can lead to ideas" [E3] (Q 8)

or as a taxonomy of terms in relation to the design process.

"The strength of the framework lies in the development of a kind of taxonomy of terms and how they fit within processes of developing a game. In that sense it is an objectification of the somewhat fuzzy world of game design. Terms that are otherwise sometimes used ambiguously." [E8] (Q 9)

The frameworks connects and maps numerous ideas/aspects that are often taken separately.

"It connects and integrates aspects that are often taken separately. In game design, development and research a lot of different disciplines can be defined and this is a very useful attempt to create an integrated interdisciplinary overview for researchers as well as producers/project managers." [E5] (Q 10)

"Compliments to you for connecting numerous ideas regarding the game design process, it seems to be solid monks work (expression for laborious, accurate work). It is good that for once this knowledge is mapped, the gaming world can take benefit from it." [E10] (Q 11)

It provides a basis from the classics, but also connects other domains to game design theories,

"You have taken the classics and connected them with knowledge from the entertainment game industry and that is definitely something new. Even more experienced people may find it useful to better connect what they are doing with scientific literature, as well as connecting other domains to game design theories." [E3] *(Q 12)*

as well as the entertainment game industry, which is important for the fun factor.

"It's a good step to look at the entertainment game industry. Indeed Duke & Geurts, as well as Casper Harteveld are operating at quite a theoretical level of translating a problem for a client into a game. In my experience those games miss the fun factor." [E6] *(Q 13)*

4.1.3.1.2. Criticisms on the framework

In this section, we mention the criticisms on the framework. While we saw in the previous section that the framework does add a practical perspective, another expert mentioned the lack of a process perspective in the figure. The "how to execute" perspective is not clear from the framework.

"Despite the many arrows and interrelations, the framework does not contain a process perspective, in the sense that the figure does not specifically show how to actually do something. It helps in distinguishing steps and determining what factors I need as input for something else, but not how to do something. For example, gameplay specifications shows several factors with "leads to", but how exactly? In that sense it does not help people at all and the process perspective is missing in the figure. The problem lies in the passive use of verbs, it might help to check whether it is possible to turn them into active verbs instead." [E8] *(Q 14)*

Another expert also adds to this. He mentions that in some way communicating (e.g. interactive visualization) additional factors to think about, at specific steps, will be adding practical value for people.

"It would be very nice for people to have, if you are in a specific step, what factors should I think about? For example, if you would want to evaluate (the aspect of) fun, what should I look at and what is known in literature. It's not necessary to mention, this is the best way, but here are the three methods known in literature, or these are elements and concepts to consider. Another example I have talked about today to students is an engagement questionnaire that measure game engagement. For instance, if I would click (in the context of an interactive visualization) on engagement (BL1.2), I would maybe get the definition of engagement, a suggestion to measure it etc. I think this would add additional practical value for people." [E9] *(Q 15)*

The framework is also too complex, which makes it difficult to communicate.

"I still feel that the framework is too complex however. It would be nice to have a simplified version of it. Perhaps you can use this elaborate, detailed version for analysis." [E2] *(Q 16)*

"If you can further develop the framework and find a way to reduce the complexity, it would be very useful for the designer." [E6] *(Q 17)*

"The scheme seems very busy. I think in terms of usability the framework is difficult to communicate." [E9] *(Q 18)*

With all these factors in the framework, there is a need to accentuate things, especially for novice designers.

"My impression and experience is that the framework is too complex for novice designers and perhaps more advanced (designers) as well. A game designer will have to accentuate things and make choices, since including everything is not possible. A novice designer will surely require assistance in that area." [E10] *(Q 19)*

This point is further accentuated below as not all factors are equally important in the model. Furthermore, not all elements are included in the framework, such as which indicators to use, the scoring system, the micro/macro cycles, etc.

> *"Not all factors are equally important, but this is not reflected in the model. Also I think there are other factors that can play a role that are not mentioned in the framework. For instance, what type of game, how many players, what game elements to choose, which actors to include to ensure enough action occurs without overloading the game… also very important are the indicators we use, how to score and the micro/macro cycles of a game, when do we take a break, do we have reflection moments in the game, or do we keep it outside of the game? " [E1]* *(Q 20)*

Another expert also finds the strategy aspect in the game extremely important.

> *"Not all factors are equally important. An extremely important point in games is the balancing of strategy. There should be some dilemma in the game and it matters what choices you make to deal with it. During the game you get feedback on those choices, which you can relate back after the game to your strategy. For instance, narrative and aesthetics are less important. Of course they are all connected, but in my opinion strategy, and related to that difficulty and challenge are highlights." [E6]* *(Q 21)*

A suggestion made by one expert to improve the usability and communication of the framework is to remove some of the detail in the framework and check for the essentials. Paired with a different form of visualization, such as an interactive wiki or HTML, the details can be shown as a pop-up or in a side-bar.

> *"On its own, the framework itself may be a little overwhelming. At the low level, you could remove some of the detail. For example, does fun really consist of those five elements, this can be debatable of course. Instead of showing this in the scheme, you could just say, fun is an element and then (in context of using an interactive visualization for references) you can refer to these and these people have said something about fun and this is a suggestion for the evaluation. In order to reduce the complexity of the framework you could leave this out of your scheme. You could do this check through the framework and ask, what parts are really important, and the details are referenced to as an option. I think there are a lot of good ideas behind the framework, but it is hard to communicate that with a scheme as complex as this. On the other hand, the strength of the framework also lies in that it illustrates the complexity of the design process and the different relations quite well. So you will have to find your own balance there, it's a strength and a problem at the same time." [E9]* *(Q 22)*

A point that is made related more to the content is that the client plays an important part throughout the entire design process, yet this is only reflected once in the design specifications in the figure. The client does not know everything beforehand and figures things out along the process.

> *"Conversations with the client are in my opinion and experience of great importance throughout the entire process. As a game designer you have to make all kinds of choices in all phases of the process. What the correct choices are is often only known after consulting the client. Furthermore, in games I have worked on it is not the case that the client 'knows' everything beforehand, but figures out along the process what the exact problem is. Continuing to the next phase is also often in conjunction with the client, is everything clear, are we on the same page?" [E10]* *(Q 23)*

It is also important to stay on the same page with client and actually give the client ownership over the game. This gives the client the feeling of control over the design, which in turn makes implementation of the game within the client's organization easier.

> *"Personally I think it is very important for the designer to cooperate with the client. Not because the client determines what has to be done in the design, but to give the client the feeling of being in control of the design. This is important for the actual implementation of the game since it is the client that has to use it.*

If you do not have those contact moments with the client, they will distance themselves from the design. The client has to become the owner of the game, it has to be their game. If done correctly, they will defend the game within their organization, if not any criticism on the game can cause it to be shutdown. For instance, after specifying the problem with the client, the game designer does his homework for let's say around 2 weeks to develop a concept. Then another meeting would take place with the client to agree to say, ok, that's what we are going to do, a type of go/no-go moment." [E6] *(Q 24)*

Aside from the client's perspective, accommodating demands and needs of the other actors also demand attention.

"How to accommodate the demands and needs of different actors in complex problems that deal with many different actors. Often these games are developed from one perspective and not everyone may agree with that perspective." [E3] *(Q 25)*

Another point is inadequately addressed, as some experts highlight. The framework lacks in the area of debriefing (and facilitation).

"Debriefing is one of the most important phases of the game and it is where people reflect and learn from the game. In my experience, even if the game is incomplete or not perfectly balanced, if the debriefing connects well, the game can be still be very valuable. It would be a pity if the framework would not also address this part." [E3] *(Q 26)*

The importance of which is further highlighted in the next quote.

"It is often said that gaming is an excuse for facilitation and debriefing, because that is where supposedly the learning happens." [E1] *(Q 27)*

The final point is that the framework should be further specified for awareness games and clarified for what this means for different steps in the design process.

"It feels that in the context of awareness games on complex systems, someone using the framework would appreciate further elaboration what it means for the design specifications, when using your definition of awareness games. At the moment it seems to be a bit too general. Perhaps it can be further specified in the problem definition. It would be great if you can clarify with a framework like this, what to do in a client consultation to analyze what criteria the problem needs to satisfy for it to qualify for the use of an awareness game." [E5] *(Q 28)*

4.1.3.2. General use of frameworks – the art vs craft discussion on game design

In this section we look at quotes on the use of frameworks in general. These comments regarding the fundamental use of a framework relates to the discussion on whether game design should be viewed as an art or a craft.

"We can argue that game design can be seen as an art, but this model implies that game design can be done as a sort of fill in exercise of the factors in the model. The framework seems to suggest that if the factors of the framework are included it will all be alright, but there are many design choices to make that do not really have a "correct" answer." [E1] *(Q 29)*

This quote mentions that there are many design choices without correct answer, which shows more of the art side perspective on game design. The following quote and cartoon highlights a more fundamental point.

"A problem with applying systems and project management theory to games is the factor of what Heisenberg called 'indeterminacy'. That is - in my words - what you design in, is not necessarily what you will get out. I've attached a cartoon that says this much more eloquently than I can."[E4] *(Q 30)*

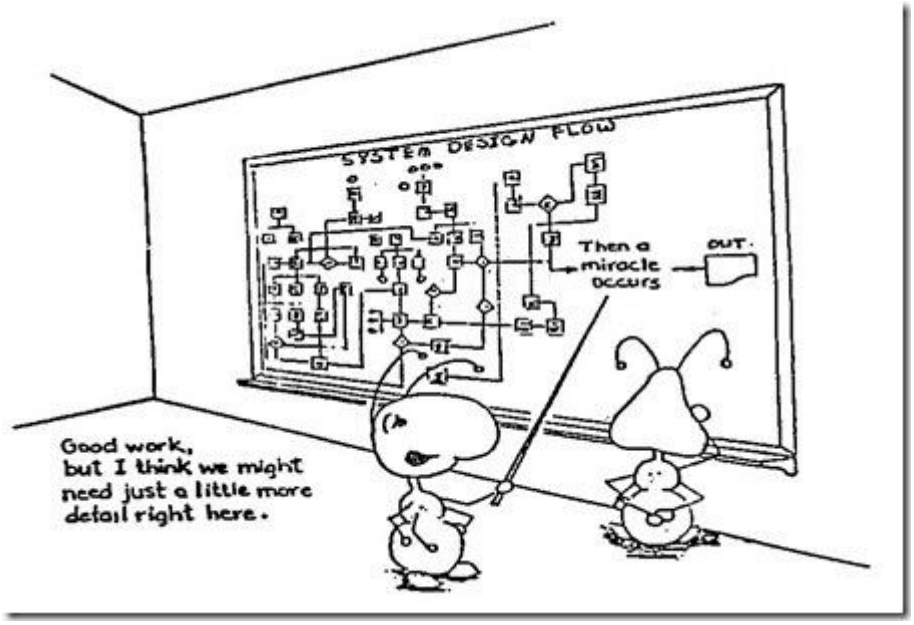

Figure 14 A cartoon highlighting a problem of applying systems theory to games: that there is an element of "magic" involved in game design that is near impossible to grasp in a system model [E4] (Source: https://thenamiracleoccurs.wordpress.com/about/)

We have addressed some of this in Chapter 1 as well. Even though another expert on the "craft" side of things accept this perspective, he mentions that systematic working creates conditions however for that "miracle" to occur.

> *"You can't force the 'x-factor' of a game, but you can create conditions in which this 'x-factor' can occur. In my opinion that's working systematically, not committing too fast to a 'format' or metaphor, but leave room for that." [E10]* *(Q 31)*

A more moderate perspective is given in the following quote, where game design is to some degree an art form, for which a matter of personal preference and experience are involved.

> *"Game design remains to some degree an art form and contains a lot of subjectivity which is difficult to capture in a model. In the end all the elements have to come together to make a complete game. Where to start in the process is a matter of personal preference. For this a lot of experience with designing games is needed." [E2]* *(Q 32)*

4.1.3.3. Structural - the structure of the framework, such as the three levels in the framework as well as the interrelations between factors

In this section, we deal with the structural comments of the framework, related to the three abstraction levels (contextual, procedural, developmental) as well as the interfaces we developed in section 3.2.

We start with the point that the criteria can be further elaborated to include in all design steps, instead of only the starting activity of each stage.

> *"Now it looks as though the criteria are only used in the starting activity of the process of each stage. In fact, you use the criteria in all three stages of the cycle. For example, the criteria cycle II, you will use in prototyping, testing but also evaluation. I would think there are criteria for design specifications, developing a system analysis and writing a concept. Each of these has a different set of criteria, which you can refer back to if you did it correctly. For example, are my specifications clear enough, is my system analysis at the right level of abstraction and is my concept understandable?" [E7]* *(Q 33)*

To have consistency with the procedural-contextual interface, everything from the contextual layer should go through criteria.

> *"Everything goes through the criteria layer. If you say "Theoretical formalization of game and game design components", this is included in the criteria for making a concept. You make choices for what (mix of) game design theories you will use. And those are your criteria, or boundaries you create, on which you base your concept. Criteria in my view are mostly three different things: what do I want to achieve with that step, or what is my goal; what am I going to do within that step, what are the activities I will do, the process; what is the expected outcome and when am I satisfied or not with the outcome. Different inputs will influence different points of those criteria. For instance, objectives can mean what do I need to achieve with the game or it can also mean it should cost less than 100.000. They will have different impact on the criteria for those three points, goal, process and outcome. Having criteria at each step also allows you to make a check after each step, and not just after the concept when it might already be a bit too late. " [E7]*
>
> *(Q 34)*

At the procedural-developmental it would make more sense that the deliverables/products are not perse linked together. To be consistent, the deliverables/products should be kept as outcomes of design steps and inputs for the next step in the game design process.

> *"There is not necessarily a link between the deliverables, but there is a link between steps in the process. Of course you can say that you use that deliverable. But that means you use that deliverable in a different step in the process and not within a different document. So then you would have the arrow from specifications going to system analysis, and system model going to concept. Also at the end (implementation stage), the deliverables are inputs for the design steps, whereas at the start, they are product of the design step. If you want to be more consistent, I would say to keep the yellow blocks as outcomes or deliverables of the design step." [E7]* *(Q 35)*

Using that same process, we should revise the deliverables cycle II and III, as well as the steps of playtesting (M2.2) and evaluating (M2.3)

> *"What is actually the difference between playtesting and evaluating? If we look at the design process, you are going to build something, you test it, then check if it satisfies the criteria..." [E6]* *(Q 36)*

The design steps of playtesting and evaluation can be merged together with an evaluation report as deliverable on how well the criteria are met.

> *"Then you have the iterations of building and testing. So the outcome of the building phase is a prototype or end product. And the outcome of testing/evaluation is an evaluation report on how well the product satisfies the criteria I have set. Actually the deliverables of your design process (building/prototyping and testing) is the game itself, but also how to facilitate and debrief the game and these are then input for your delivery. The outcome of facilitation are game results, quantitative or qualitative. And debriefing in my practice is ending in "so what?", what are we going to do with this outcome, what action will we undertake in reality. So the outcome is an action plan, or an insights gained list, a document that translates the game experience to reality. Then there is an evaluation step to judge whether further development is necessary or not. Did the game reach its intended goal or not? This step can be used to evaluate if the players learned anything, but also if anything should be changed." [E7]* *(Q 37)*

Additionally, we can change the deliverables of building/prototyping phase to game/prototype as well as the facilitation/debriefing document that is now in cycle III. The product of the facilitation is the results of the actual game play. Whereas the debriefing results can be summarized in a document that translates game experience to reality, such as an action plan or a list of gained insights.

An evaluation step can then be added after debriefing. From here in criteria cycle III, it should (also) loop back to delivery, since rather than re-design, you can also change the mode of delivery (e.g. facilitating or debriefing).

> *"You have one very large feedback loop, saying ok this is what we delivered, what are the learning points and I think you are more likely to change the mode of delivery. It's possible to redesign the game, but that's rather theoretical. Once you have decided to deliver the game, it has been tested already and you hope everything is correct. For example, after running a game, you can change the way of facilitating or debriefing for next time. Occasionally you have to build something in (the game) afterwards, but most of the time you adapt the delivery mode. Then every phase has its own loop. If at the end you decide something needs to be changed, you can loop back to the specs or the design." [E7]* *(Q 38)*

Another important point is related to balancing. It is somewhat misplaced currently since it is an important step that is also already relevant in the development of the gameplay specification, as is showed by the following quotes.

> *"Why are things like story, character and game world here (in the gameplay specifications) and something like flexibility and relevance not there (but in balancing). It is a little bit odd that there is a mismatch between terms what you design for and what you balance for. It might be that what you now have under gameplay specifications leads to a rough version, a test, whereas that (factors in balancing) gives a lot more detail." [E3]* *(Q 39)*

> *"Balancing is extremely important, but we also use that already before playtesting. Playtesting is a way to check the balance…. Actually in the design phase you are already considering mechanisms for balancing. For example, I am a big fan of using the rule of three, the rock-paper-scissors principle (intransitive relation)." [E6]* *(Q 40)*

> *"Things like rewards, punishments, surprise, aesthetics etc. you also have to look at in the gameplay specification." [E9]* *(Q 41)*

Balancing is better seen as a process than a deliverable that is more connected to aiding building/prototyping.

> *"Balancing (L7) seems more like a process, than a deliverable or product. As I see it, every step in the process has a certain output, so balancing seems to be a little misplaced. Balancing is actually something that should support choices in the design. So it is actually connected to building/prototyping, a sort of additional layer that will help me to execute this. It is an activity that will help me to build the prototype or product." [E7]* *(Q 42)*

> *"What is the difference between the gameplay specification and the concept? The things listed in the gameplay specification are things that should also sort of be dealt with in the concept phase. These are the input for your design. I would couple L3 with L4 (concept and gameplay specification) and use that as input into prototyping. Then I have balancing as an in-between step, before building the prototype. Balancing can be seen as your levers to get from the concept to the desired result." [E6]* *(Q 43)*

A potential solution to this misplacement is to move the current factors under gameplay specifications to the concept report and have the factors under balancing as "levers" for building/prototyping.

There may be many more different relations between the factors in balancing, which is what we have also stated in section 3.2.3.

> *"It is possible to draw many more different relations between the factors and in the end it is all somehow connected. It is however important to mention these factors." [E3]* *(Q 44)*

A final point is the inconsistency with the interrelationships. The framework uses the arrows that depict them in an inconsistent manner.

> *"The arrows seem to be depicting different things. You can see that in the use of verbs, questions and definitions (at the arrows). Additionally, some of these factors on the one hand represent processes, on the other hand they represent components." [E1]* *(Q 45)*

4.1.3.4. Content - the content of the framework, such as the adaptation, addition or removal of factors in the framework

In this section we deal with the comments related to the content of the framework. This means any adaptation, addition or removal of factors in the framework.

For clarity purposes it is easier to merge the names of the criteria cycles (IP3.1-IP3.3) and stages (M1-M3) as they essentially denote the same.

> *"It is a little confusing that you have criteria cycle …, but also concept stage, production stage and implementation stage. Actually those stages are cycle 1, cycle 2 and cycle 3." [E7]* *(Q 46)*

At the contextual level theories/methodologies on facilitating and debriefing should be added.

> *"Usually part of the design philosophy also includes, how you are going to play/facilitate it but also how are you going to make sure that 'the learning happens'. So how do I get players to learn something through debriefing. The method for facilitating and debriefing is also based on theories/methods. I miss this part within the context." [E7]* *(Q 47)*

The inclusion of Maslow's model (BL1.9.1) is too outdated and better left more general, as there is a whole academic field behind motivational theories.

> *"Regarding motivational theories, there are many other models and Maslow's model is old and has been criticized a lot as well. It might be better to not further specify this. Similarly, there are many theories regarding learning in relation with games. This is also the case with fidelity and narration for example. They basically have complete academic fields behind them." [E3]* *(Q 48)*

> *"Regarding motivational theories I would choose something else since Maslow's model is outdated and criticized a lot. Take a look at for example self-determination theory, for which some of the research interest has actually been sparked by games. Or perhaps list something like extrinsic and intrinsic motivation." [E5]* *(Q 49)*

The factor "Design philosophy" (CT6) should also be colored green.

> *"Design philosophy also has a number of theories behind it, so I would also color this green." [E7]* *(Q 50)*

The use of the awareness definitions developed alongside the design framework could be incorporated better within the framework. For instance, measurement method with quasi-experimental model with pre and post measurements, as well as in-game background measurements.

> *"It would be interesting to see more on when specifically awareness games are successful. Based on the buildup of the awareness definition, a complex problem, the learning domains of Bloom and complex systems, you can think of a creative way to define criteria for the evaluation of games. In terms of techniques, it requires at least a quasi-experimental model with valid pre and post measurements, combined with in-game measurements background. Yet these still require criteria to be developed based on the definition of awareness." [E5]* *(Q 51)*

The problem statement could be further accentuated and elaborated with a methodology for defining the problem statement.

> *"In organizations often you may find a mismatch between how they define the problem and how the players or target group of your game experience the problem. It is important to give this sufficient attention." [E3]* *(Q 52)*

> *"As a designer you know very little of the underlying problem, so if you want to have deeper learning you need the knowledge of the experts. You need a moment with designer and experts together to expose things that are critical for the design. It will take some time to dig deeper into the root of the problem. We do that in a day-long session starting at 10:00 and we do not leave the room until we have defined the learning objective that everyone agrees on. We do that by filling in a 3x3 matrix, an adaptation on the work by Harteveld." [E6]* *(Q 53)*

This could be done for instance by means of the following the matrix in Table 21.

Table 21 A methodology to aid in determining the design specifications, involving the filling in of a 3x3 matrix based on Harteveld (2011) as used by [E6].

	Reality (current state)	**Meaning / Transition (desired state)**	**Play (Game format)**
Target group	What are they currently working on?	What should they be working on?	What groups should be in the game?
Knowledge	What is currently known? / How do they view things?	What is the learning goal?	What choices should be made in the game? (Core mechanism)
Result	What are we measuring or going to measure?	What is a successful result?	What is the game over condition?

There are multiple system models and the one in the framework focusses too much on actors only.

> *"There are many different types of actor analysis and system analysis, with a whole academic field behind them. Although games often deal with actors, it seems incomplete. Think of different types of relations such as regulations, causal or economic." [E1]* *(Q 54)*

> *"The system analysis is now very focused on actors and does not include many other system elements." [E3]* *(Q 55)*

In the current gameplay specifications (L4), roles should be included, perhaps instead of characters (GS1.1.3), which is more related to entertainment game design.

> *"I am missing the inclusion of roles within the gameplay specifications. You do have characters (in the framework), which is somewhat connected and in entertainment games you often see that roles are represented by characters. However, in our games what roles are included can often play an important role. [E3]* *(Q 56)*

The feedback mechanisms, in terms of how the player receives information should also be factored in.

> *"Here I miss what balancing principles you are going to use, as well as feedback mechanisms. During the game, very clear feedback mechanisms are required. A game is based on action and reaction with consequences and that should be communicated immediately. If not, the player is not aware of what he has done or should be doing to successfully complete the game." [E6]* *(Q 57)*

In prototyping (L5), a digital game should also be internally complete and have a functional structure,

> *"The digital game should also be internally complete and have a functional structure." [E3]*
>
> *(Q 58)*

A method for playtesting (M2.2) should also be included, instead of just a procedure (PE1-PE4).

> *"You also need to figure out how to log your feedback. You need to guide the playtesters in a concrete manner. What did you see and what did you expect to see, are there bugs, if so what did you do to trigger it? It requires some sort of playtest methodology." [E6]* *(Q 59)*

For instance the different stages of a playtest in talkthrough, crawlthrough, walkthrough and runthrough.

> *"The first thing we do is a talkthrough, then a crawlthrough, walkthrough and runthrough." [E7]* *(Q 60)*

What to test for in a playtest is also important. For example, balancing the difficulty vs skill will have to be tested with "tissue tester" (someone who has not played the game before), since the design team themselves know the game too well. It is also important to see if there is sufficient information feedback to the player.

> *"A designer is already good at the game, since he has developed it and played it many times already. This results in two blind spots. The first being that the game keeps growing more difficult because you want to challenge yourself. We almost always notice that the missions have to be made easier for the actual players. The second being feedback. Because you know all the mechanisms in the game, there are things that are very logical for you as a designer, but this may not be the case at all for the player. It is very important to test if the player receives the required information." [E6]* *(Q 61)*

For the third cycle or implementation stage, there are several suggested additions:

To the "completed product" (L8) deliverable we could add the mode of distribution;

> *"The distribution, how you offer the product is very important. How can the player reach the game? Is it a boardgame that everyone plays around a table, or a digital one that you play at home that is monitored from afar, or is it within a workshop?" [E6]* *(Q 62)*

for the debriefing, Kriz (2010) provides a structure with various steps;

> *"Kriz provides a structure with various steps on how to execute debriefing, which could be added to the framework" [E3]* *(Q 63)*

additionally, the debriefing should reflect on the chosen strategy, or highlighted important parts.

> *"The debriefing should reflect back on the chosen strategy in the game. What did you do, what were your expectations in the game, how close were the results to these expectations? This reflects the chosen strategy. Why did you gain the highest score, what did you do to get that score?" [E6]* *(Q 64)*

at the end of the process, once the game is played and debriefed, a final report can be added.

> *"Then there is a report, with what data did I gather and what conclusions can be drawn from them. A sort of big data analysis, as usually you get a lot of data if you do it well, since you can measure anything in the game." [E6]* *(Q 65)*
>
> *"At the end you can say there is a final report." [E7]* *(Q 66)*

4.1.3.5. Other comments

In this section, we mention any other comments we have received.

Several tests could be done to improve the value of the framework.

> *"If the framework is to be used as a check for completeness, then you would have to prove however that game design processes without these aspects are worse design processes, or perhaps some are mandatory and others are not. For example, you could look at what the relation is between the design process of successful and non-successful games and assess whether certain components are present or not. Alternatively you could test the framework with students of game design and give half the framework and the other half not, and test the quality of the game design process" [E8]* *(Q 67)*

For instance, research could be done into the relation between factors in the design process of successful and non-successful games and assess the presence of certain components.

Another could be to test the framework with game design students using the framework and a control group.

> *"You could setup a workshop where you have a group of people who have seen the framework and a group who did not. Of course this will have some methodological issues, such as that some people might be better game designers by nature. You could still measure things like, did you have issues in thinking about the design process, what kind of design process were you trying to follow, did you find it difficult to etc." [E9]* *(Q 68)*

Game analytics or stealth learning could be included as an in-game evaluation technique.

> *Regarding evaluation to use game analytics or stealth learning could be used for in-game measurement. The RAGE project provides a tool with several modules that can help to incorporate this in an easy and accessible way. [E5]* *(Q 69)*

In regards to "Working in the magic" related to Figure 14, the inclusion of theories regarding self-referencing adaptivity could help as an attempt to capture a certain "magic" within the framework.

> *"To do what you are aiming to achieve requires adding something like what might be called 'self-referencing adaptivity. Biology, and climate science are places to look for such systems. Mandelbrot figures, and chaos theory are involved. And as you are crossing boundaries - spanning the boundaries - between 'exact' and 'inexact'/fuzzy science, it will be a 'chaordic' process [ref - Dee Hock] at best."[E4]*
>
> *(Q 70)*

Finally we received some additional references to look at

- Dan Cook's atomic design elements[2] and Joris Dormans' advanced game mechanics[3] [E9]
- Björk & Holopainen – Patterns in game design[4] [E2]

[2] https://www.gamasutra.com/view/feature/129948/the_chemistry_of_game_design.php?page=3

[3] Adams, Ernest & Dormans, Joris (2012). *Game Mechanics: Advanced Game Design.* San Francisco, USA: New Riders Press.

[4] Björk, Staffan & Holopainen Jussi (2004). *Patterns in Game Design (Game Development Series)*. Rockland, MA, USA: Charles River Media.

4.1.4. Summary and reflection on results of game design expert feedback

In this section we summarize and reflect on the results of the game design expert feedback. We start of with the fundamental feedback we received and how to address their comments. Then we look at the concrete adjustments that could be made to the framework.

4.1.4.1. Fundamental

We start with summarizing the fundamental feedback.

Use of framework in general

We briefly touch upon the use of a design framework in general, in relation to the game design as an art vs craft discussion. As we have seen in section 4.1.3., this remains a discussion, also amongst experts. A moderate standpoint may be to say that it is a matter of preference and the usefulness of the framework will depend on the user.

From our point of view we definitely accept that to a certain degree game design is an art. In no way does the framework does not claim to be able to generate successful awareness games through a systemic process. This is also not what we set out to do in Chapter 1. Rather, we aimed to provide more concrete practical guidance in designing awareness games and integrating existing game design frameworks into a more comprehensive framework.

Strengths of the framework

Here we summarize the main strengths of the framework as we extracted from the expert feedback:

- The framework is unique in that a framework such as this one has not been seen before by the experts. The core structure is solid, yet it sets up for more practical application as opposed to the high-level literature.
- The framework presents an overview of the design process, filled with useful ideas and concepts.
- It connects important aspects that are often taken separately, from different domains as well as from the entertainment game design industry
- There are various uses of the framework the experts mentioned:
  - check
  - guideline
  - inspiration for generating ideas
  - taxonomy

Criticisms

In the same manner we summarize the main criticisms on the framework as we extracted from the expert feedback:

- The framework lacks a process perspective, in that it is unclear from just the framework how to execute specific steps.
- The framework is too complex, which makes communication of the concepts difficult. A better visualization of the ideas and concepts in the framework is warranted.
- The interrelationships are depicted in an inconsistent manner.

- Not all factors in the framework are equally important. Accentuating of the most important concepts is needed. Some of them are mentioned such as client representation, problem analysis and debriefing.
- The design cycle III or implementation stage is inadequately represented, especially facilitation and debriefing.
- The framework is insufficiently specified for awareness games. It would be good to include what to do specifically for awareness games in certain design steps.

There are some ways in which we can address these criticisms as we show in Table 22.

Table 22 Potential ways to address criticisms by game design experts on the framework.

Criticisms	Potential ways to address criticisms
-Lack of process perspective -Too high complexity of framework -Inconsistent representation of interrelationships	An important way to address these points of criticisms is to change the method of visualization, into a more interactive version such as a wiki or HTML. For instance, in a sidebar or pop-up window we can add guiding text to address the process perspective on how to execute certain steps. We can remove some of the lower level detail from the figure and add it to the guiding text to reduce some of the complexity. With the different visual representation we can also clean up the interrelationships.
-Accentuating important aspects	Before being able to accentuate the important aspects, we will have to identify them first. The experts mentioned some of the important aspects such as client representation (Q23, Q24), accommodating other perspectives (Q25), debriefing and facilitation (Q26,Q27, Q64) and the problem analysis (Q52, Q53). However, additional research and/or interviews with game design experts will have to be done to identify what aspects are in fact the most important in designing awareness games.
-Inadequate representation of design cycle III or implementation stage	As we mentioned in section 3.2.3., the implementation stage was underdeveloped in the literature we studied. The experts have made some recommendations on how to improve this section, which we will deal with in a more concrete manner in section 4.1.4.2. Nevertheless, additional research is also required to adequately add to the implementation stage. For example, the work by Kriz (2010) was mentioned by one expert.
-Insufficiently specified for awareness games	Addressing this point will also require additional research. Particularly on the characteristics of awareness games, what sets apart awareness games from other games. In our definition in Chapter 1, we provided a definition that is more goal-oriented, but we have not identified what in terms of game elements distinguishes awareness games from other games. Once that is established, we can more clearly specify what is important to develop those elements for awareness games.

4.1.4.2. Concrete adjustments to framework

In this section we summarize what concrete adjustments we could make to the framework, based on the game design expert feedback. We do so in the same structure as we have in section 3.2., starting out with the procedural level, the two interfaces, the contextual level and finally the developmental level.

Procedural level

- For clarity purposes we can merge the naming of the design cycles (IP3.1-IP3.3) and stages (M1-M3). This means merging concept stage and cycle I, production stage and cycle II, and finally implementation stage and cycle III.
- We can merge the design steps playtesting (M2.2) and evaluating (M2.3) as they are generally taken together.
- We should reposition balancing (L7) as a process step to aid building/prototyping, not a deliverable.
- We can add an evaluation step at the end of the design process that loops back to delivery (M3.1).

Procedural-contextual level interface

- For consistency purposes we should have everything in the contextual layer go through the criteria (IP3.1-IP3.3).
- The criteria should then also be further elaborated to be included in all design steps (M1.1-M3.4).

Procedural-developmental level interface

- For more consistency and clarity, the deliverables/products (L1 – L10) should be outputs of the design steps, which are then used as input for the subsequent design step.
- In that light we should revise deliverables in cycle II and cycle III:
    - Building/prototype (M2.1) – should have the game/prototype, facilitation and debriefing document as output.
    - Facilitation (M3.2) – should have game results as output.
    - Debriefing (M3.3) – should have a document translating game experience to reality, e.g. action plan, list of gained insights as output.

Contextual level

- We should include theories/methodologies on facilitating and debriefing
- Design philosophy (CT6) should also be colored green

Development level

- We could have the inclusion of roles (instead of characters perhaps) in gameplay specification (L4). Characters (GS1.1.3) are more related to entertainment game design, whereas roles are more important for awareness games.
- We could move factors currently in gameplay specification (L4) to concept report (L3), and factors in balancing (L7) to gameplay specification (L4) as levers to tweak.
- For the system model (L2), other perspectives than actor analysis (SM2) should be mentioned.
- A method for playtesting should be added such as, how to log feedback and the process of talkthrough, crawlthrough, walkthrough and runthrough. What to test for in playtesting (L6) is an

important point, such as balancing difficulty vs skill (to test with “tissue tester”), and whether the amount of information feedback to the player is sufficient.

- In prototyping (L5), a digital prototype should also be internally complete (PT1.1.2) and have a functional structure (PT1.1.1).
- In balancing (L7), a factor of competition/collaboration could be added to fun (BL1.1).
- To add to the completed product (L8), we could look at the distribution of the game.
- As a final deliverable to the client, we could add a final report.

Limitations of the expert feedback

There are a number of limitations to the evaluations as we have done with the expert interviews. Firstly, not all of the adjustments are necessarily backed by each of the experts. As we have mentioned in 4.1.3., if a topic is only addressed by one or two experts in the results we presented, other experts have not commented on that topic. In order to address that, we could have presented the adjustments to the game design experts for additional feedback. Due to time constraints of both the researcher and the experts we have not managed to do so. Secondly, the feedback is based on a review by the game design experts and not actual use in practice. Thirdly, the selection of game design experts is geographically concentrated in the Netherlands. It may be that these game design experts have a similar background in game design, that could be different when consulting game design experts in other geographical locations. For example, the Australian game designer we interviewed commented mostly on the fundamental use of frameworks and was not similarly rooted with a system’s perspective on game design.

4.2. Analysis of CE Delft game design using the design framework

The second method of evaluation is a more empirically oriented study, using the design framework. We will use it to analyze a game designed by the author for CE Delft, a consultancy company specialized in environment and sustainability issues. We will first describe the game that was developed. To do the analysis we first identify what the main issues were during the design process. Then we analyze whether we can explain why those issues occurred based on the framework and see in what way the use of the design framework may have been able to resolve some of those issues.

4.2.1. Description of the CE Delft game

The topic of the game deals with the use of GDP (Gross Domestic Product) as an indicator for welfare. GDP has long been used as a proxy for measuring social welfare (WRR). However, the GDP indicator was never originally intended as a measurement tool for welfare. In the early 20th century its development was stimulated by wartime when there was a need for measuring production capacity. For several decades now, the use and interpretation of GDP as proxy for social welfare has received much criticism from for instance Kuznets (1941), Hicks (1948), Sen (1976), Kahneman et al. (2004), Stiglitz et al. (2009). A summary of these limitations (not exhaustive):

- Does not take into account higher levels of well-being, subjective well-being, happiness
- Does not take into account widening inequality
- Is a flow indicator, does not take into account balance sheet. For example, country with large oil reserves will do well on GDP measurement. But is not a measure of sustainable growth. The other way around, taking on large sums of loans can also increase GDP but is not necessarily healthy for long term economic growth.
- Does not distinguish between activities. Paradox of GDP that destructive activities also increase GDP.
- No external costs incorporated, such as environmental costs and strain on natural resources. In fact, GDP stimulates it.
- Formal economy measured, informal economy not (e.g. services, free time not incorporated)

The objective of the CE Delft game was to generate awareness for the limitations of GDP as an indicator for guiding public policy and measuring social welfare. It should also start the discussion for alternative well-being indicators. Below we will give a short excerpt of how the game is setup. In Appendix A, a more elaborate description can be found.

The game we ended up with is an analog board game, in which the objective is to make policy decisions in teams to develop islands in the best way possible. The teams are scored on two different metrics, an economic indicator and a well-being indicator. The team with the highest score wins.

The players are divided in teams, with each of the teams having five different roles to play. The roles represent ministries, that each have their own responsibilities with different policies related to it, to potentially push through. The game is played in rounds, with each round having three different phases.

Phase 1 – Information: At the start of each round, every island is given information regarding their current scoring.

Phase 2 – Update: The players receive their income to make policy decisions in the next phase. Events drawn from event cards are also resolved.

Phase 3 – Decision making: The players discuss the policies they would like to implement. The different policies that the players can implement are listed for each of the players. Each of the policies have a different impact on the game and the eventual scoring. The master of coin in each of the teams is in charge of the distribution of the finances.

After a set amount of rounds, the game is finished and the scores are checked based on the policy decisions made by the teams. The players are debriefed to check what impact the metric had on the chosen policies.

4.2.2. Main issues during design process

In Appendix A the (incomplete) documentation of the game design process can be found. Here we note the first issue, which is the documentation of the game design process. It was unclear which sections of the game design process require detailed documentation and eventually to what end such documentation would be used. As we can see in Appendix A, the design specifications and the system analysis are relatively well documented. This was easier to complete and document as there was a clear step-wise procedure to follow. However, when entering the game development process it was much more chaotic. First of all, there was no step-wise procedure to follow. We went from idea generation to concept to story to testing to balancing using trial and error and back to idea generation. There were too many unstructured jumps and design choices that it would take a lot of time and effort to document and make sense of.

The second issue was managing expectations and related to that a third issue of defining the problem that required solving and objective of the game. The client had an overall mission of convincing policymakers to utilize a different indicator to measure welfare in a country than GDP. This mission is comprised of several steps however, such as showcasing the limitations of GDP, developing a different indicator, showcasing why and if it is better than GDP and how the new indicator should be implemented. Originally, the client wanted the complete picture. Additionally, the client had a digital game in mind in which policymakers could explore the results of their policies based on GDP or a potential different indicator. After looking into the various steps we realized that within the scope of the project we could only realistically tackle one of those steps. On top of that, with the time and financial constraints of the project it was much more likely to complete a physical game rather than a digital game. This was a far cry from the original expectation of a digital game tackling the client's overall objective. As an inexperienced designer I wanted to tackle the big objective, but in hindsight, this was very unrealistic and a lot of time could have been saved by managing those expectations early on. Eventually, we settled on limiting the scope of the game objective to raising awareness in policymakers surrounding the limitations of GDP. Even though we had limited the scope, defining the objective concretely was still a problem. What exactly is meant with raising awareness and which part of the system to create awareness for (e.g. awareness of the current system, the desired system or the path from the current to the desired system) were questions that remained only vaguely answered.

The fourth issue was choosing the right mode of representation. In managing expectations we already touched upon choosing a digital or a physical game. Besides the amount of time and finances it takes to develop a digital game, there is also the question of which mode fits the objective better. In the end we have chosen for a physical game, but the question of which mode would fit the objective better remains unanswered. Other considerations that regarding the mode of representation are the level of realism and

level of detail for the game. In the end the choice for realism and detail was made more on the basis of playability, rather than if it would fit the objective.

The fifth issue was choosing game elements and mechanics. The most pressing part here is that we did not know what game elements and mechanics would be able to contribute to the objective of raising awareness. Additionally, it was difficult to choose which actors to include in the game and how they would be played. In the system analysis we identified nine key actors. We also wanted to play with three groups simultaneously, with all three groups receiving slightly deviating indicators. The reasoning behind this was to spark discussion in the debriefing on how these indicators could influence decision making. This would hopefully raise awareness to the limitations of using GDP as indicator for policy decisions. However, if all actors were to be included and the game would be played with three groups, this would mean we would need 27 players to play the game. This was a lot more than could be accommodated for. Eventually, we combined several actors together to form five playable roles per group.

This brings us to the sixth issue of playtesting. The five playable roles per group and desire to use three different groups still required 15 players to play the game. For the playtests it was difficult to get together 15 players to play the game. This meant that only one or two groups were being played during tests. While this allowed us to balance for those two groups, the dynamic interaction between the three groups was often neglected. This was especially an issue because that interaction was designed to be a major facilitator of discussion during the debriefing of the game.

The seventh issue was balancing the game. The issue with balancing was a cascading effect of the issues we mentioned earlier. Firstly, the lack of a well-defined concrete objective made it difficult to focus on the objective. Balancing game elements and mechanics towards the objective was also difficult since we did not know what would contribute to raising awareness. This was also made increasingly difficult because the playtesting was not conducted with the full intended three groups. Therefore, we instead mostly balanced for playability and fun, which was easier to evaluate.

The eighth and final issue we discuss is evaluating the effectiveness of the game. Again, because of the lack of a well-defined concrete objective, it was difficult to determine how to measure the effectiveness of the game. As a result, in the end, we did not develop a proper evaluation methodology.

4.2.3. Analysis using the design framework

Now that we have identified the main issues during the design process, we revisit the design framework (see Figure 13) to see whether we can explain why the issues occurred and how it could be potentially have been used to resolve (some of) these issues. We also refer back to the strengths of the framework that we identified in section 4.1.4. The analysis using the design framework is presented below in Table 23.

Table 23 Analysis of how the design framework could be used to explain and potentially resolve some of the main issues identified during our design process.

Main issues	Explanation of issue based on design framework	Potential use of design framework to resolve issue
Documentation	As illustrated by the framework, the design process is very complex with many different steps and factors involved. The framework shows a total of 10 different products / deliverables that ought to be developed throughout the design process. Aside from the design specifications and the system analysis, there was no template or overview of what to document for different phases in the design process, how to document it or what it would eventually be used for.	The framework provides a structure for how the game design process could be documented. It also explicitly mentions the specific products / deliverables that should be developed for each step of the design process. The framework also provides factors to consider or that can contribute to developing those documents. If there are difficulties during those steps, the framework can also be checked for references to literature for further guidance.
Defining the problem / objective	We did not realize that the phase in which the design specifications and the system analysis is developed, is in fact, a cyclical process. A lot of time was spent to factor in the very complex and complete picture into the system model, based on the initial wishes of the client. Only after this time was spent we still had to decrease the scope and more time had to be invested to readjust. If we had tried to develop a concept from an earlier version of the system model, we would probably have realized much sooner that the initial scope was far too large to tackle within one game. Additionally, we had not found a clear way to define awareness and it may have been that the client and designer were operating under a different idea of the concept of awareness.	The framework addresses this at some points. It links to objective-focused models on the input side, various factors that go into developing the right criteria and it shows that getting the right scope of the problem can go over multiple cycles. In addition, the definition of awareness in Chapter 1 might make it easier to define the objective. However, judging from the expert feedback in section 4.1.3., this issue may be better resolved with more adequate client representation and a better problem analysis, which is currently not reflected well in the framework.
Managing expectations	Probably the main source that managing expectations had become an issue is that the expectations were never explicitly concretely defined at the start of the project. This eventually meant that the	The framework explicitly reminds the user to define the expectations in the design specifications steps. It also presents cyclical iterations in which the design specifications are revised. This also means that it is possible to redefine expectations (one of the

	expectations of the client, the designer and his supervisors were all different for a long time during the design process. This is however clearly listed in the framework (DS3.3).	factors of the design specifications) during the design process. Structurally including this within the framework remind the designer that expectations can be revised during the design process.
Choosing mode of representation	From the expert feedback we have received on the design framework, we see that even expert game designers find that choosing the right mode of representation for the game is still very difficult. In the framework, choosing the mode of representation is not discussed however.	Unfortunately the framework does not give any concrete guidance regarding the choice of the mode of representation. The framework does provide an overview of the design process, which might give novice designers a better idea of what factors play a role in making a choice.
Choosing game elements and mechanics	Similarly, from the expert feedback we have received, choosing game elements and mechanics is also one of the major issues during design. During the design of the CE Delft game, we did not know of the existence of LM-GM models, that could have been used to guide decision making regarding game mechanics.	The framework provides several factors that can be considered for game elements and mechanics. It also provides reference to LM-GM models that we discussed in section 2.1.2. However, in terms of awareness specific game elements, additional research has to be done as we mentioned in section 4.1.4.
Playtesting	Playtesting should have been used to answer specific questions. These were not formulated well enough beforehand. Even though the game was meant to be played with 15 players, if questions were more focused they could likely also have been answered with less players.	As the framework is in the current state, the framework does prompt to ask specific questions. However, a clear method is not presented for playtesting. From the feedback from game design experts in section 4.1.3., adjustments are suggested that will help to improve playtesting and address this issue.
Balancing	At the time of designing we had used Triadic Game Design and were aware of the concept of balancing for the three worlds of Reality, Meaning and Play. However, which levers that are available to balance them was not known.	The framework provides clear criteria for which to look for during balancing, as well as factors that may potentially influence those criteria. These factors can be used to spark ideas on how to balance the game. It can also give support on how to approach balancing in a structured way.
Evaluating	We did not have a measurable definition for awareness, such as the one developed in conjunction with this framework in Chapter 2. Neither were we aware of the use of certain evaluation methodologies.	The framework provides reference to evaluation methodologies that we examined in section 2.1.1. In addition, the definition of awareness in Chapter 1 provides a basis for measurement. However, more work has to be done on developing an evaluation methodology for awareness games.

As we can see from Table 23, the framework would do well in tackling issues regarding:

- Documentation – clearly presents overview of design process and which documents/deliverables can be expected in each design step
- Managing expectations – clearly presents the need for defining expectations, which can be revised over the course of several iterations
- Balancing – shows a wealth of different factors that can be used as levers for balancing

We find that further improvement is required regarding the following issues:

- Defining the problem / objective – Better inclusion of client representation and problem analysis will help to address the issue of defining the problem and determining the right scope.
- Playtesting – The inclusion of a methodology for playtesting will help make playtesting more efficient and effective.

This is also consistent with what we have found in section 4.1.4. More research is required to address the other issues:

- Choosing right mode of representation – Even for a game design expert this is still a very difficult issue to deal with, as illustrated by Q20. More research will have to be done in this topic and even then, maybe there simply is no “correct” mode of representation.
- Choosing game elements and mechanics – Before being able to choose game elements and mechanics, more research is to be done on what elements would aid in developing successful awareness games. The LM-GM models described in section 2.1.1. may provide some direction, but they are more specified towards educational games.
- Evaluating – A validated evaluation methodology for awareness games specifically is currently lacking as far as we know and will need to be developed.

Chapter 5: Implications for practice and theory

In this Chapter, we zoom out from the content of the framework and look at the more general implications it has for practice and theory. For this, we refer back to the framework of the design science research methodology in Figure 1. We reflect back on the relevance cycle to discuss the practical application of the framework we developed. We then also reflect back on the rigor cycle to discuss what the framework, as well as our learnings during the development of the framework, add to the knowledge base.

5.1. Reflection on relevance cycle, practical use of framework

In this section, we discuss our reflection on the relevance cycle, the application of the framework for practical use. In section 4.2. we have seen some practical use of the framework where we used it to evaluate what issues it could potentially have helped resolve in our own game design process. We firstly look at how this relates to issues in awareness game design in general. These reflections represent ex-post use of the design framework however. We will thus also discuss the possibilities of the framework for when it is used throughout the entire game design process.

5.1.1. Use of framework for awareness game design issues

As we have mentioned, we have already seen the application of the framework to aid in various issues in a case of a design process in section 4.2. Now we refer back to the issues that designers of awareness games identified experience, as we have described in Chapter 1. We summarize those issues and how the framework addresses them in Table 24.

Table 24 Awareness game design issues and how the framework could be used to address them.

Awareness game design issues	**How the framework can address the issues**
Translating field-specific knowledge into the game	The objective-focused models are fit into the design framework and provide input into the design process.
Balancing complexity and learning objective	The framework elaborates on balancing and integrates the triadic design frameworks that provide criteria and perspectives for balancing.
Incorporating stakeholder perspectives	The client perspective is included in the concept stage in terms of defining objectives and the design specifications. Adjustments still need to be made to better incorporate this into the framework.
-Finding correct degree of abstraction -Determining appropriate format -Determining game elements	These issues are actually the same as we have encountered in our own evaluation in section 4.2.3.

There is a clear distinction between the type of issues the framework addresses and which issues it does not address. The first three issues in Table 24 are process-related issues on how to do something, whereas the other issues are more related to difficult design decisions. We can relate this to the art vs craft discussion from section 4.1.3.2. The framework can address the more process-based issues in a systemic "craft" manner. However, with regard to the difficult design decisions such as the degree of abstraction,

game format and game elements the frameworks provide little guidance. This might just be the art part of game design, where the creativity and experience of the game designer come to fruition.

Table 24 is very similar to Table 2 regarding which of the issues are addressed. From those tables, it may seem that we have not added a whole lot. The difference being that the frameworks in Table 2 are now integrated into our framework, which is also exactly what we set out to do. These issues served as an illustration in Chapter 1 to the incompleteness of the current methodologies, but do not form a complete set of issues that currently exist in awareness game design. More research will have to be done on the issues that awareness game designers encounter, to figure out what other issues the framework might be able to address. Because in the process of integrating the various game design frameworks and entertainment game design literature, we feel that we have developed a framework that is also usable in a broader context, which we illustrate below.

5.1.2. Potential use of the framework for awareness game design

In this section, we discuss a more general use of the framework. Based on the feedback we received from the game design experts we have found a number of strengths and uses of the framework which we summarize below, taken from section 4.1.4.:

- Solid core structure
- Overview of the design process, filled with useful ideas and concepts
- Connects important aspects, from different domains, including entertainment game design industry
- Various uses:
    - check
    - guideline
    - idea generation
    - taxonomy

Based on these points we will discuss several uses of the framework during the design process at different stages.

Start

At the start of the design project we find the following uses for the framework:

- **Planning** – The framework provides a core structure and overview of the design process. At the start of the project, the design team can use the overview to plan each of the design phases and use it to discuss what has to be done.
- **Communication** – Another important use of the framework is communication, for the design team, as well as towards the client. It can help to get the design team on one page and sketch the outline for what they are going to do. In terms of client communication, it serves to illustrate the design process, what the client can expect from the various design steps and what their role is in the design process. The client will better understand the planning and the cyclical nature of the design process.

Ongoing

During the design project we find the following uses for the framework:

- **Monitoring** – The framework can be used to keep overview for the project leader, to keep track of where the design team is in the design process and whether the process is on schedule.
- **Documentation** – The framework clearly presents what deliverables to develop during each of the design steps. It can be used to accurately keep track of the documentation for each of the deliverables.
- **Planning** – In case there are delays with the planning set out at the start of the project, the overview provided by the framework can help to give an indication of where in the process this time may be regained.
- **Balancing** – As we have seen from both the triadic design frameworks in section 2.1.1. and the entertainment game design literature in section 2.2., there are a lot of different factors to balance. The framework provides a structure for those factors in terms of criteria to balance for and concepts that may help to generate ideas for the balancing process.
- **Idea generation** – In the same vein, whenever the designer is stuck, the concepts and ideas in the framework may be able to help generate ideas and check references. Eventually, the framework could also be used as a more detailed practical guidebook. As we mentioned in section 4.1.4., with an interactive visualization we can add a lot more lower level guidance. The interactive visualization in the form of a wiki, for instance, allows us to have as many layers of depth as we want. All the layers we identified in the coding process from Appendix D could be added with guiding texts to form a much more complete "handbook". The framework we currently have can serve as a basis to generate such a handbook.

End

At the end of the design project we find the following uses for the framework:

- **Check** – Once the project is almost finished, the framework can be checked to see whether everything is included that was planned and whether the documentation is complete.
- **Evaluation and analysis** – Since the framework structures the design process and documentation, it is possible to review the steps that were taken during the design process. This can be used to pinpoint where any issues were encountered in the design process, or what went well and should be repeated.

We note that the design process structure may differ for different designers and game design companies. The framework should not be seen as a static figure, but is customizable to the needs of the designer who uses it. It should be seen as the basis for developing a living and evolving guideline that gets updated with the lessons and ideas learned over the course of the many game design projects.

5.1.3. General implications of the framework

In section 1.1., we introduced the relevance of awareness games for solving complex problems. We have seen that well-designed awareness games could be applicable to a wide variety of topics such as organizational decision making, protecting innovations, fostering a shared company culture, but also topics in public awareness. We believe there are several drawbacks of awareness games for organisations: it has a long development time, it requires a lot of resource investment and the resulting effect is subject

to uncertainty. How well the awareness game actually works can only be determined at the later stages of the development process, when a working prototype is available. Even then, we have seen in previous Chapters that the evaluation methods are lacking for awareness games.

From a management perspective, it is important to be able to compare the effectiveness of awareness games to other methods. This is required to be able to make a cost-benefit analysis to decide whether or not an awareness game is desired. It is also important to decrease the development time for awareness games, to lower the cost of production. We believe that our framework has the potential to do so by addressing numerous project management aspects such as monitoring, planning and more efficient client communication.

We also think that the direction of the development of the framework has the potential to be a start for developing a "dominant design". If developers of awareness games would use similar design processes to construct their games, we can compare and analyze the design processes to determine what works and what does not. This allows us to better understand the design process and find patterns for awareness game design. We can decrease the development time of awareness games as we require fewer iterations to "get it right". We believe that eventually, this framework can help to optimize the "craft side" of game design, so that the design process produces higher quality games and leads to more consistent results. This makes it a more reliable tool for organisations to pick up awareness games. Working on improving the craft side of game design will allow us to compare

Followers from the "art" perspective on game design might disagree and argue that the magic of games will be lost. To answer this we can compare this to the development of cars for instance, or many other design related products. To car enthousiasts, designing cars is an art form and not something that can be made from a systematic formula. However, there is a craft side to making cars as well. Over the course of history, we have seen continual improvement of this side to get cars to the point where they are today. Take for example the Ford assembly line or Toyota's development of lean manufacturing.

We thus believe that viewing awareness game design as a technological development that can be optimized, will be to the benefit of the adoption of awareness games. This framework may be a relevant step in that direction.

5.2. Reflection on rigor cycle, adding to the knowledge base for awareness game design

The main addition we can make to the knowledge base is the culmination of everything we have learned during the development of the framework. This will be reflected in an adjustment of the framework we developed in Chapter 3, based on the evaluation in Chapter 4. We will then discuss the difference between our framework and other game design frameworks that we have analyzed to illustrate the additions. Finally, we discuss what we ourselves have learned from the whole development process.

5.2.1. Adjusting the framework

In this section, we deal with the adjustments to the framework we can make based on the evaluations we have done in Chapter 4. We take stock of the suggested adjustments and compare that to the game design literature we analyzed in Chapter 2 and our own design choices in Chapter 3. We cross check for conflicts and discuss whether the adjustments are justified or not and how they should be implemented. We start with the adjustments we can implement already in Table 25. We then further describe adjustments to be made that require additional work.

Table 25 Discussion on suggested adjustments from Chapter 4 to implement in the framework.

Suggested adjustments	Discussion
Contextual level	
Include theories/methodologies on facilitating and debriefing	This is inadequately represented in literature, as mentioned in section 3.2.4. and thus should be added.
Design philosophy (CT6) colored green	One source for "Design philosophy" was Harteveld's work on Triadic Game Design and it could thus have been colored green in the first place.
Procedural-contextual level interface	
Everything in the contextual layer goes through the criteria (IP3.1-IP3.3)	In section 3.2.2. we struggled to place "Theoretical formalization of game and game design components" (CT3) and were unsure of how it would relate to the criteria. There is no conflict with the literature and it makes sense in terms of consistency to adjust.
Criteria elaborated to include in all design steps (M1.1-M3.4)	During the development of the framework, we had in mind that the criteria would drag over from one step to the next and would be referred back to at the final step of each stage. However, the framework is more complete if criteria are defined for each of the design steps.
Procedural level	
Merge naming design cycles (IP3.1-IP3.3) and stages (M1-M3)	There is no conflict with the literature and the suggestion adds to clarity.
Merge playtesting (M2.2) and evaluating (M2.3)	Playtesting and evaluation are generally mentioned in one breath. Since we also do not have a specific deliverable related to evaluating, it will help with consistency in the framework.
Reposition balancing (L7) as process step for building/prototyping	In section 3.2.3. we struggled with positioning balancing. This was thus a welcome suggestion to adjust its positioning.
Procedural-developmental level interface	
Deliverables/products (L1 – L10) outputs of design steps and inputs for subsequent design step	From the game design literature we did not find any specific structure on the deliverables. This suggestion adds to the consistency of the framework.
Revise deliverables in production stage (M2) and implementation stage (M3): -Building/prototyping (M2.1) -Facilitation (M3.2) -Debriefing (M3.3)	Regarding building/prototyping, the suggestion was made that the facilitation and debriefing document should be provided for in this step as input for the delivery (M3.1) to the client. Facilitation leads to game results that is used as input for debriefing. Debriefing results lead to a document that translates the game results to concrete action in the form of an action plan or list of insights gained.
Developmental level	
Roles instead of characters (GS1.1.3)	As the expert mentioned in Q56, characters relates more to entertainment game design, which is where we have extracted the factor characters from. This suggestion serves to specify the framework more towards awareness games.
Move factors from gameplay specification (L4) to concept report	In section 3.2.3. we made a conscious choice for keeping the development of the concept report to abstract levels, since the examined literature did not provide consensus on how to

(L3) and factors from balancing to gameplay specification (L4)	develop it. We abstracted it to core concept and core mechanics that would be elaborated more in later stages. The detail of the core is not specified however. In developing the factors for gameplay specifications, we used the high level merged categories from section 2.2.3. We essentially extracted elements that could be seen as the 'core'. Even though the suggested adjustment differs from our original design choice in Chapter 3, it is not conflicting with what we have found either. Combined with the repositioning of balancing we discussed earlier, this adds to more concrete guidance in the framework on how to develop the concept report as well as the gameplay specifications.
Digital prototyping (PT1.2) also internally complete (PT1.1.2) and functional structure (PT1.1.1)	In the source from which we extracted these factors (Fullerton, 2008), the context was that a physical prototype should 'at least' be internally complete and have a functioning structure. While not mentioned explicitly, there is no reason not to extend it to digital prototyping as well.
Factor of competition/collaboration added to fun (BL1.1)	Schell (2008) also mentions the factor of competition vs collaboration under balancing and could thus be added without conflict.
Add distribution mode to delivery (M3.1)	The distribution mode in entertainment games is generally fixed at the start of the project (e.g. analog vs digital game, platform for release) and is difficult to adjust once completed. For awareness games, there is more flexibility in facilitating and debriefing as we see in Q38.
Add final report as final deliverable	None of the examined literature provides any mention of a final report as final deliverable. From a practical point of view it makes sense to summarize the results in a final report.

Based on our discussion in Table 25, we find that there is no conflict between the suggested adjustments from Chapter 4, the game design literature we examined in Chapter 2 and the design choices we made in Chapter 3. We will thus implement all these adjustments in the framework, which is illustrated in Figure 15.

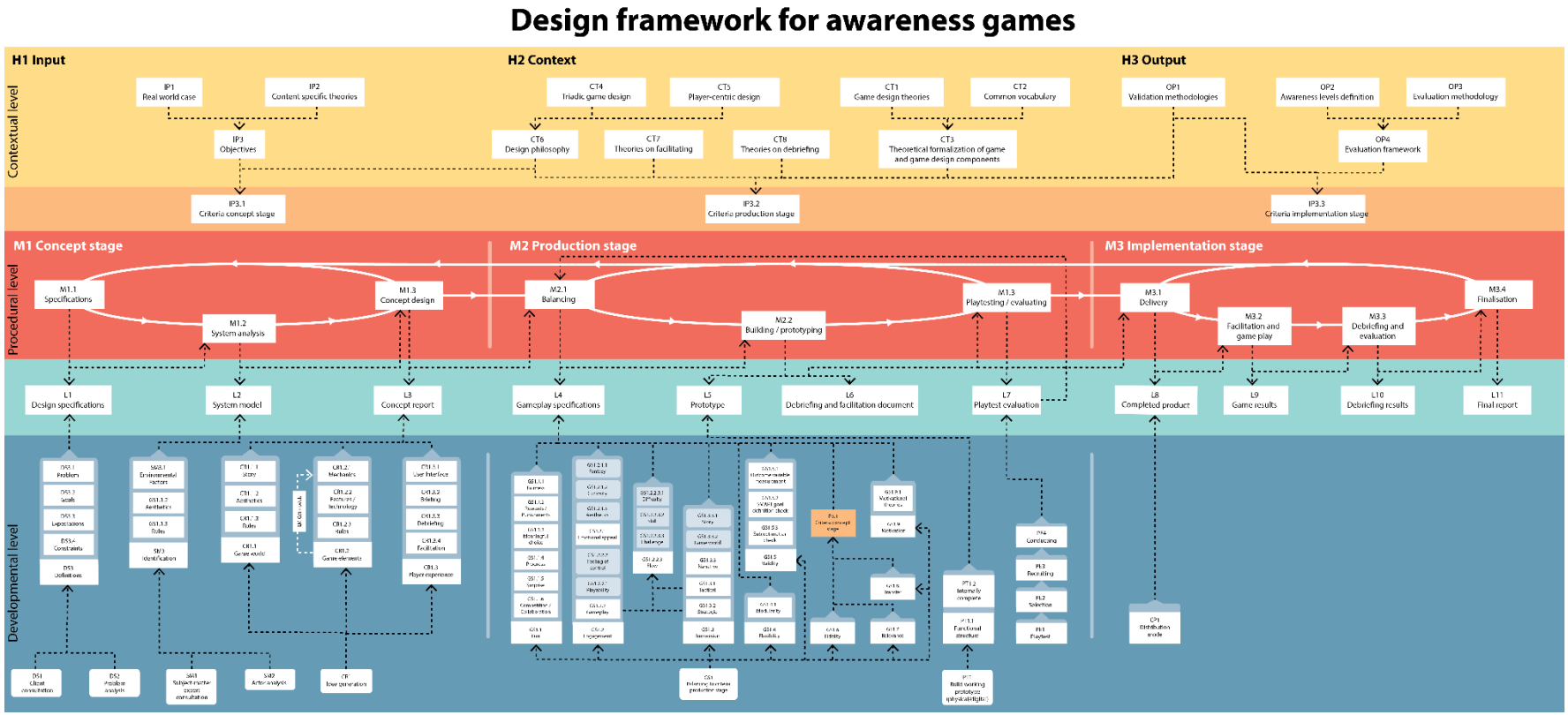

Figure 15 Updated version of framework based on suggested adjustments after evaluation.

There were other suggested adjustments in sections 4.1.4. and 4.2.3. that we could not implement immediately but require further work. We summarize them below in Table 26 and discuss how it can impact the framework once that work has been done.

Table 26 Impact of suggested adjustments on framework once further developed.

Suggested adjustments	Impact on framework
Interactive visualization of framework	An interactive visualization allows for multiple layers of detail. At the top layer, the core structure would remain intact. At the procedural level, the design stages, design steps, criteria and documentation would remain. The details from the contextual level on how to develop the criteria as well as the details from the developmental level on how to develop the documentation could be moved to more in-depth layers.
Research/interviews on most important aspects to be able to accentuate factors in the model	Once the most important aspects have been identified this can result in a different visualization of the factors to accentuate them. In combination with the interactive visualization, the layers can be structured based on importance.
Research for further input on implementation stage, facilitating and debriefing.	These would simply be additions to the framework, as they are currently not well-addressed.
Research for further specifying awareness games. Determining characteristics of awareness games, important elements for awareness games, how to develop them and how to evaluate them.	At the contextual level, this will help to generate more in-depth guidance on how to specify the criteria, specifically for awareness games, for each of the different design steps. At the developmental level, it can aid with more detailed guidance on how to choose game elements specifically for awareness games.
Further elaborate on problem analysis, within the system model	This will add to the detail in developing the system model (L2). Instead of only looking to start with actor analysis, we could add multiple entry-ways to analyse the problem. The work of Enserink et al. (2010) might provide good additions.
Further elaborate on methods for playtesting	This will add to the detail in doing the playtest evaluation (L6). Apart from the procedural perspective that is now listed, a methodology will add more concrete guidance.

5.2.2. Additions to the knowledge base

Now that we have adjusted our framework, we can compare what our framework adds to the knowledge base, compared to the other design frameworks that we analyzed in section 2.1. In section 1.4. we highlighted that the design science research methodology is based on increasing knowledge and understanding through the act of building. Below we summarize our main learnings throughout our development process.

- In section 2.1.2. we distinguished three abstraction levels from which to view the game design process.
- In Chapter 3 we identified a core structure for the design process and integrated other frameworks to that structure that relate to:
    - Integrating objective
    - Game design taxonomy
    - Balancing perspectives
    - Evaluation & validation
    - Game design process structure
    - Concrete design guidance
- In Chapter 3 we also connected concepts from the entertainment game design literature to that core.
- In Chapter 4 we find, based on expert feedback, that the framework provides a unique overview of the game design process.
- Based on the evaluations in Chapter 4, we highlighted the practical relevance of the framework in section 5.1.

As we have pointed out in section 2.1.2., the design frameworks we analyzed in section 2.1.1. only take into account specific parts of the design framework. Our main addition here is that we identified those parts and interrelated them through the core structure of the design process as developed in Duke & Geurts (2004). In that process, we generated a unique overview of the design process. We then also added concepts from the entertainment game design literature to add to the practical value of the framework.

5.2.3. Limitations of the framework

Even though we have illustrated the potential practical relevance of our framework, we have not discussed the fact that in current practices for awareness games design frameworks are not being used. It is a question we will have to ask practitioners why they are not using a design framework and what they would require of a framework to be beneficial to them. From our own perspective, the incompleteness of the existing design frameworks and the lack of practical guidance play a large role. To some extent, we feel that we have somewhat mitigated those concerns, but our design framework certainly also has a number of limitations:

- Despite having integrated many design frameworks, our framework is still not complete in covering the design process. There is plenty work to be done to make adjustments and additions to the framework as we highlighted in Table 26.
- Although we evaluated the potential usefulness of the framework with game design experts and an ex-post analysis of our game design process, the framework still needs to be proven in application. It has not yet been used to design actual awareness games and will thus need to be empirically tested before being widely applicable.
- There are fundamental limitations to what the framework can provide as we have seen from the art vs craft discussion that featured in 4.1.3. and 5.1.1. Regarding difficult design choices, game design remains an art and is not something we can tackle with a design framework.

Chapter 6: Conclusions and recommendations for future work

In this Chapter, we present our conclusions and provide recommendations for future work.

6.1. Conclusions

We started out with identifying that the existing design frameworks are incomplete and lack in concrete guidance for designing awareness games. We set our research objective to tackle this by working towards a more comprehensive framework for the design of awareness games, in which we position existing game design frameworks, leading to the following research question:

> *How can we integrate existing game design frameworks into a more comprehensive game design framework for awareness games?*

In order to integrate the existing game design frameworks, we developed a core structure based on Duke & Geurts (2004) their design sequence and made additions based on the observation that the existing design frameworks operate at three different levels of abstraction:

- The contextual (high) level contains frameworks looking at the input, context and output of the game design process. They help determine the criteria for the steps in the design process.
- The procedural (medium) level contains the structure of the design process, with the various design stages and steps.
- The developmental (low) level contains more concrete details on how to develop the deliverables in each of the design steps.

These levels in combination with the design sequence by Duke & Geurts (2004) formed an initial framework. In order to address issues regarding the lack of concrete guidance, we analyzed entertainment game design literature and complemented that framework. Based on game design expert evaluation and an analysis of a game design process case, we made additional adjustments. The resulting framework provides a unique overview of the game design process, that integrates existing game design frameworks and incorporates more elements of the game design process than existing game design frameworks currently do.

We have also found the potential practical relevance of the framework in the design process and can help with planning, communication, monitoring, documentation, balancing, idea generation, checking, evaluation and analysis.

6.2. Limitations of the research

There are a number of limitations to the framework however. At present it is not yet complete and more work has to be done to finalize it, in terms of content as well as visualization. The framework is also not yet tested empirically and needs to be proven in practice. Finally, we have found fundamental limitations to a framework in general, as frameworks seem to be unable to capture all aspects of game design

6.3. Recommendations for future work

The design framework we have developed is a structure that connects many different domains. The avenues for future work are endless. We provide a selection of suggestions that we would find most interesting.

General use for a design framework

In sections 4.1.3., 5.1.1 and 5.2.2. we touched upon the art vs craft discussion and the use of design frameworks in general. In section 1.1. we discussed that in current practices for awareness games, design frameworks are not being used at all. This raises several questions that would be interesting to research: Why are design frameworks not being used currently? Are they unknown to designers and do we need more awareness for design frameworks? Do designers view game design much more from the art side and find no need for a design framework? Or are current design frameworks too inadequate in dealing with the issues a game designer faces that it is not worth using? We could interview game designers in practice to determine what issues they most commonly deal with and where they would find use for a design framework, if at all.

Validation of our design framework

A crucial step in application of our design framework is its validation. The most important would be to conduct empirical tests. This could be done for example with game design students using the framework to design games and other students without the framework as a control group. Another possibility to generate quick results is to approach game designers to use the framework at game jams. These are gatherings where participants design games within a short time span ranging between 24 and 72 hours.

Another way to increase the validity of the framework is to do research into successful vs non-successful game design processes and compare that to what the framework prescribes.

Improvement of our design framework

In section 5.2.1., Table 26, there were suggestions related to the improvement of the framework that we could not yet implement and require additional work:

- The development of an interactive visualization is one of the most important ones for the usability of the framework. It reduces the complexity of the figure and also allows more layers of detailed guidance to be added.
- Much more work has to be done on better specifying aspects of the framework for awareness games:
    - What are the defining characteristics of awareness games?
    - What are the most important aspects in developing awareness games?
    - What game elements help to successfully generate awareness?
    - How to evaluate the effectiveness of awareness games?
- More research on facilitating and debriefing is required, to adequately provide guidance in these steps.

Adaptation of our design framework for other domains of game design

We also note that while we have developed our design framework specifically for awareness games, many of the steps we have undertaken to develop the design framework were neutral as to the type of game we are developing. As a result, we have a lot of work to do on specifying for awareness games. However, this also means that it may be adaptable for other domains of game design. Further research for those specific domains may be able to tell to what extent our design framework is useful for that domain and how to adapt it accordingly.

Effectiveness of awareness games and comparison with other tools

Finally, we touch upon a key point that can help advocate the use of awareness games. In order for awareness games to be considered more widely, their effectiveness needs to be better evaluated. Research needs to be done on how to evaluate awareness games so it is possible to compare them with other tools. Organisations looking to use awareness games can then make better informed decisions on when to use them. Awareness game designers can also use it to their advantage to push forward their products.

References

Adams, E., & Rollings, A. (2007). *Game design and development: Fundamentals of game design*. Upper saddle river, New Jersey, USA: Pearson Education, Inc.

Ahmad, M., Rahim, L. A., & Arshad, N. I. (2015). Towards an effective modelling and development of educational games with subject-matter: A multi-domain framework. *2015 5th International Conference on IT Convergence and Security, ICITCS 2015 - Proceedings*, (August). http://doi.org/10.1109/ICITCS.2015.7293027

Aleven, V., Myers, E., Easterday, M., & Ogan, A. (2010). Toward a framework for the analysis and design of educational games. *DIGITEL 2010 - The 3rd IEEE International Conference on Digital Game and Intelligent Toy Enhanced Learning*, 69–76. http://doi.org/10.1109/DIGITEL.2010.55

Amory, A. (2007). Game object model version II: A theoretical framework for educational game development. *Educational Technology Research and Development*, *55*(1), 51–77. http://doi.org/10.1007/s11423-006-9001-x

Arnab, S., Lim, T., Carvalho, M. B., Bellotti, F., De Freitas, S., Louchart, S., … De Gloria, A. (2015). Mapping learning and game mechanics for serious games analysis. *British Journal of Educational Technology*, *46*(2), 391–411. http://doi.org/10.1111/bjet.12113

Bateman, C., & Boon, R. (2006). *21st Century game design* (1st ed.). Hingham, Massachusetts, USA: Charles River Media, Inc.

Bloom, B. S. (1956). *Taxonomy of educational objectives; the classification of educational goals* (1st ed.). New York, USA: Longmans, Green.

Bots, P., & van Daalen, E. (2007). Functional design of games to support natural resource management policy development. *Simulation and Gaming*, *38*(4), 512–532. http://doi.org/http://dx.doi.org/10.1177/1046878107300674

Braad, E., Gregor, Ž., & Sandovar, A. (2016). Processes and Models for Serious Game Design and Development. In R. Dörner (Ed.), *Entertainment Computing and Serious Games* (pp. 92–118). Cham: Springer. http://doi.org/10.1007/978-3-319-46152-6

Brewer, J., & Dourish, P. (2008). Storied spaces: Cultural accounts of mobility, technology, and environmental knowing. *International Journal of Human Computer Studies*, *66*(12), 963–976. http://doi.org/10.1016/j.ijhcs.2008.03.003

Carvalho, M. B., Bellotti, F., Berta, R., De Gloria, A., Sedano, C. I., Hauge, J. B., … Rauterberg, M. (2015). An activity theory-based model for serious games analysis and conceptual design. *Computers and Education*, *87*, 166–181. http://doi.org/10.1016/j.compedu.2015.03.023

Choo, A., Eylül Işcen, Ö., & Karamnejad, M. (2013). Serious indie games for social awareness: Gamifying human characters with disabilities. *1st International Conference on Gameful Design, Research, and Applications, Gamification 2013*, 83–86. http://doi.org/10.1145/2583008.2583020

De Freitas, S., & Oliver, M. (2006). How can exploratory learning with games and simulations within the curriculum be most effectively evaluated? *Computers and Education*, *46*(3), 249–264. http://doi.org/10.1016/j.compedu.2005.11.007

De Jans, S., Van Geit, K., Cauberghe, V., Hudders, L., & De Veirman, M. (2017). Using games to raise awareness: How to co-design serious mini-games? *Computers and Education*, *110*, 77–87. http://doi.org/10.1016/j.compedu.2017.03.009

Denning, T., Lerner, A., Shostack, A., & Kohno, T. (2013). Control-Alt-Hack: the design and evaluation of a card game for computer security awareness and education. *CCS '13: Proceedings of the 2013 ACM SIGSAC Conference on Computer & Communications Security*, 915–928. http://doi.org/10.1145/2508859.2516753

Depigny, S., & Michelin, Y. (2007). SHRUB BATTLE: Understanding the making of landscape. *Simulation Gaming*, *38*(2), 263–277. http://doi.org/10.1177/1046878107300666

Dionnet, M., Kuper, M., Hammani, A., & Garin, P. (2008). Combining role-playing games and policy simulation exercises: An experience with Moroccan smallholder farmers. *Simulation & Gaming*, *39*(4), 498–514. http://doi.org/10.1177/1046878107311958

Douven, W., Mul, M. L., Son, L., Bakker, N., Radosevich, G., & Hendriks, A. (2014). Games to Create Awareness and Design Policies for Transboundary Cooperation in River Basins: Lessons from the Shariva Game of the Mekong River Commission. *Water Resources Management*, *28*(5), 1431–1447. http://doi.org/10.1007/s11269-014-0562-x

Duke, R. D. (1974). *Gaming: the future's language*. New York, USA: SAGE Publications.

Duke, R. D., & Geurts, J. L. A. (2004). *Policy Games for Strategic Management: Pathways into the Unknown*. Amsterdam: Dutch University Press.

Endsley, M. R. (1995). Toward a Theory of Situation Awareness in Dynamic Systems. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *37*(1), 32–64. http://doi.org/10.1518/001872095779049543

Enserink, B., Hermans, L., Kwakkel, J., & Thissen, W. (2010). *Policy Analysis of Multi-Actor Systems* (1st ed.). Amsterdam, The Netherlands: Boom Lemma Uitgevers.

Fleurbaey, M. (2009). Beyond GDP: The Quest for a Measure of Social Welfare. *Journal of Economic Literature*, *47*(4), 1029–1075. http://doi.org/10.1257/jel.47.4.1029

Frank, A. (2007). Balancing Three Different Foci in the Design of Serious Games: Engagement, Training Objective and Context. *Situated Play, Proceedings of DiGRA 2007 Conference*, 567–574. Retrieved from http://www.digra.org/dl/db/07312.29037.pdf.

Fullerton, T. (2008). *Game Design Workshop: A Playcentric Approach to Creating Innovative Games* (2nd ed.). Burlington, USA: Elsevier Inc. http://doi.org/10.1007/s13398-014-0173-7.2

Hansmann, R., Scholz, R. W., Francke, C.-J. A. C., & Weymann, M. (2005). Enhancing environmental awareness: Ecological and economic effects of food consumption. *Simulation & Gaming*, *36*(3), 364–382. http://doi.org/10.1177/1046878105279116

Hauge, J. B., Kalverkamp, M., Forcolin, M., Westerheim, H., Franke, M., & Thoben, K.-D. (2014). Collaborative Serious Games for Awareness on Shared Resources in Supply Chain Management. In *Advances in Production Management Systems. Innovative and Knowledge-Based Production Management in a Global-Local World* (pp. 491–499). http://doi.org/10.1007/978-3-662-44736-9_6

Hevner, A. R., March, S. T., Park, J., & Ram, S. (2004). Design Science in Information Systems Research. *MIS Quarterly*, *28*(1), 75–105. http://doi.org/10.2307/25148625

Hicks, A. J. R. (1948). The Valuation of the Social Income-a Comment on Professor Kuznets' Reflections. *Economica, New Series*, *15*(59), 163–172.

Huizinga, J. (1955). *Homo ludens; a study of the play-element in culture*. Boston, USA: Beacon Press.

Hunicke, R., LeBlanc, M., & Zubek, R. (2004). MDA: A Formal Approach to Game Design and Game Research. *Workshop on Challenges in Game AI*, 1–4. http://doi.org/10.1.1.79.4561

Ibrahim, R., & Jaafar, A. (2009). Educational games (EG) design framework: Combination of game design, pedagogy and content modeling. *Proceedings of the 2009 International Conference on Electrical Engineering and Informatics, ICEEI 2009*, *1*(August), 293–298. http://doi.org/10.1109/ICEEI.2009.5254771

Jesse Schell. (2008). *The Art of Game Design - A Book of Lenses*. Burlington, USA: Elsevier Inc.

Kahneman, D., Krueger, A. B., Schkade, D., Schwarz, N., & Stone, A. (2004). Toward National Well-Being Accounts. *The American Economic Review*, *94*(2), 429–434.

Kelle, S., Klemke, R., & Specht, M. (2011). Design patterns for learning games. *Int. J. Technology Enhanced Learning*, *3*(6), 555–569. http://doi.org/10.1504/IJTEL.2011.045452

Kiili, K. (2005). Digital game-based learning: Towards an experiential gaming model. *Internet and Higher Education*, *8*(1), 13–24. http://doi.org/10.1016/j.iheduc.2004.12.001

Kiili, K., Lainema, T., de Freitas, S., & Arnab, S. (2014). Flow framework for analyzing the quality of educational games. *Entertainment Computing*, *5*(4), 367–377. http://doi.org/10.1016/j.entcom.2014.08.002

Kiong, L. W., & Logenthiran, T. (2016). Developing a strategical smart grid game and creating smart grid awareness through games. *IEEE PES Innovative Smart Grid Technologies Conference Europe*, 154–159. http://doi.org/10.1109/ISGT-Asia.2016.7796378

Kortmann, R., & Harteveld, C. (2009). Agile game development: lessons learned from software engineering. In *Proceedings of the 40th Annual Conference of the International Simulation and Gaming Association (ISAGA 2009)*. Singapore.

Kriz, W. C. (2010). A systemic-constructivist approach to the facilitation and debriefing of simulations and games. *Simulation and Gaming*, *41*(5), 663–680. http://doi.org/10.1177/1046878108319867

Kuechler, B., & Vaishnavi, V. (2008). On theory development in design science research: Anatomy of a research project. *European Journal of Information Systems*, *17*(5), 489–504. http://doi.org/10.1057/ejis.2008.40

Kuznets, S. (1941). Statistics and Economic History. *The Journal of Economic History*, *1*(1), 26–41.

Melthis, J., Brown, A., Tang, S., & Hanneghan, M. (2016). Using Serious Games to Create Awareness on Visual Impairments. *Proceedings - 2015 International Conference on Developments in eSystems Engineering, DeSE 2015*, (December), 165–170. http://doi.org/10.1109/DeSE.2015.65

Mitgutsch, K., & Alvarado, N. (2016). Purposeful by design?: a serious game design assessment framework. In *Proceedings of the International Conference on the Foundations of Digital Games (FDG '12)*. New York.

Ong-Flaherty, C., Valencia-Garcia, D., Martinez, D. A., Borges, W., & Summers, L. (2017). Effectiveness of gaming in creating cultural awareness. *Learning, Culture and Social Interaction*, *12*, 149–158. http://doi.org/10.1016/j.lcsi.2016.12.005

Peters, V., & Van de Westelaken, M. (2014). *Simulation Games - A concise introduction to the design process*. Retrieved from: http://www.samenspraakadvies.nl/publicaties/Simulation%20games%20-an%20introduction%20to%20the%20design%20process.pdf

Rollings, A., & Morris, D. (2004). *Game Architecture and Design*. Indianapolis, Indiana, USA: New Riders Publishing.

Rooney, P. (2012). A Theoretical Framework for Serious Game Design: Exploring Pedagogy, Play and Fidelity and their Implications for the Design Process. *International Journal of Game-Based Learning*, *2*(4), 41–60. http://doi.org/10.4018/ijgbl.2012100103

Salen, K., & Zimmerman, E. (2004). *Rules of Play: Game Design Fundamentals*. Cambridge, Massachusetts: MIT Press. http://doi.org/10.1093/intimm/dxs150

Saunders, M., Lewis, P., & Thornhill, A. (2009). *Research methods for business students* (5th ed.). Harlow, United Kingdom: Pearson Education Limited.

Schilit, B., Adams, N., & Want, R. (1994). Context-aware computing applications. *First Workshop on Mobile Computing Systems and Applications*, 85–90. http://doi.org/10.1109/WMCSA.1994.16

Schuytema, P. (2007). *Game design: A practical approach* (1st ed.). Boston, Massachusetts, USA: Charles River Media.

Sekaran, U., & Bougie, R. (2012). *Research methods for business: A skill building approach* (5th ed.). Chichester, United Kingdom: John Wiley & Sons Ltd.

Sen, A. (1976). Poverty: An Ordinal Approach to Measurement. *Econometrica*, *44*(2), 219–231. http://doi.org/10.2307/1912718

Serrano-Laguna, Á., Manero, B., Freire, M., & Fernández-Manjón, B. (2017). A methodology for assessing the effectiveness of serious games and for inferring player learning outcomes. *Multimedia Tools and Applications*, 1–23. http://doi.org/10.1007/s11042-017-4467-6

Starks, K. (2014). Cognitive behavioral game design: A unified model for designing serious games. *Frontiers in Psychology*, *5*(FEB), 1–10. http://doi.org/10.3389/fpsyg.2014.00028

Stiglitz, J., Sen, A. K., & Fitoussi, J. (2009). The measurement of economic performance and social progress revisited: Reflections and Overview. Retrieved from: https://hal-sciencespo.archives-ouvertes.fr/hal-01069384

Strauss, A., & Corbin, J. M. (1990). *Basics of qualitative research: Grounded theory procedures and techniques*. Thousand Oaks, California, USA: Sage Publications, Inc.

Suttie, N., Louchart, S., Lim, T., Macvean, A., Westera, W., Djaouti, D., & Brown, D. (2012). In persuit of a "serious games mechanics" : A theoretical framework to analyse relationships between "game" and "pedagogical aspects" of serious games. *Procedia Computer Science*, *15*, 314–315. http://doi.org/10.1016/j.procs.2012.10.091

Torres, M., & Macedo, J. (2000). Learning Sustainable Development with a New Simulation Game. *Simulation & Gaming*, *31*(1), 119–126. http://doi.org/10.1177/104687810003100112

Van Staalduinen, J. P. (2012). *Gamers on Games and Gaming: Implications for Educational Game Design*. Delft University of Technology.

Venable, J. (2006). The Role of Theory and Theorising in Design Science Research. *Proceedings of DESRIST*, 24–35. http://doi.org/10.1.1.110.2475

Warmelink, H., Valente, M., Tol, R. Van, & Schravenhoff, R. (2016). Get It Right! Introducing a Framework for Integrating Validation in Applied Game Design. In *International Conference on Games and Learning Alliance* (Vol. 10056, pp. 461–470). http://doi.org/10.1007/978-3-319-50182-6

Wee, B. Van, & Banister, D. (2016). How to Write a Literature Review Paper? *Transport Reviews*, *36*(2), 278–288. http://doi.org/10.1080/01441647.2015.1065456

Wenzler, I. (1997). Take five: Gaming/simulation design process. In *Proceedings of ISAGA 1996* (pp. 251–259). Riga, Latvia.

Westera, W., Nadolski, R. J., Hummel, H. G. K., & Wopereis, I. G. J. H. (2008). Serious games for higher education: A framework for reducing design complexity. *Journal of Computer Assisted Learning*, *24*(5), 420–432. http://doi.org/10.1111/j.1365-2729.2008.00279.x

Winn, B. M. (2009). The Design, Play, and Experience Framework. In R. E. Ferdig (Ed.), *Handbook of Research on Effective Electronic Gaming in Education* (Vol. III, pp. 1010–1024). London: Information Science Reference. http://doi.org/10.4018/978-1-59904-808-6

Appendix A: CE Delft game case study description

In this Appendix the documentation is given that was done as part of the development of the game for CE Delft.

A1. Phase 1 –The Design specifications

The first phase is the design specifications phase. At the start of the process it is important to clearly delineate the problem represented in the simulation game, the context surrounding the problem and what the expectations are concerning the game. This information is not only valuable for the design process, but also for the evaluation of the finished product. The information can be categorized within six main topics:

1. Background of the problem represented in the simulation game
2. Goals of the simulation game
3. Design process
4. General design considerations
5. Elements of the simulation game
6. Use of the simulation game

A1.1. Reality - background of the problem

The world of reality at the design specifications stage leads us to consider the real world problem context. The problem context the case is considering, is the use of GDP as a proxy for social welfare. Policymakers have increasingly been using GDP as a proxy to measure social welfare over the past decades (WRR, 2010). Since policymakers have used it for decades already, why is this a problem now and to who is this a problem? GDP has in fact been criticized for a long time already and this criticism has been reoccurring over the years. GDP measures economic activity but ignores inequality of wealth distribution, destruction of the natural environment, household production as well as many determinants of well-being such as quality of social relations, health, economic security and personal safety (Sen (1976), Kahneman et al. (2004), Stiglitz et al. (2009)). These limitations of GDP can lead governments astray in their assessment of economic policies (Fleurbaey, 2009). Ultimately this is a problem for society. We can see this reflected in two major macro developments of the last decades: climate change and the economic crisis in 2008. GDP did not take into acc ount the destruction of the natural environment, nor did it foresee the issues with debt based growth that triggered the crisis. In both cases GDP growth was measured and governments were not alarmed to change their policies. A second issue is that in modern Western societies GDP growth may not necessarily increase social welfare. Referring to Maslow's hierarchy of needs, GDP relates mostly to the lower, materialistic needs of people. In modern Western society these are comparatively well-provided for (0.1% homeless in the Netherlands, CBS). Higher level needs however are not addressed by GDP. This is illustrated in Figure 16.

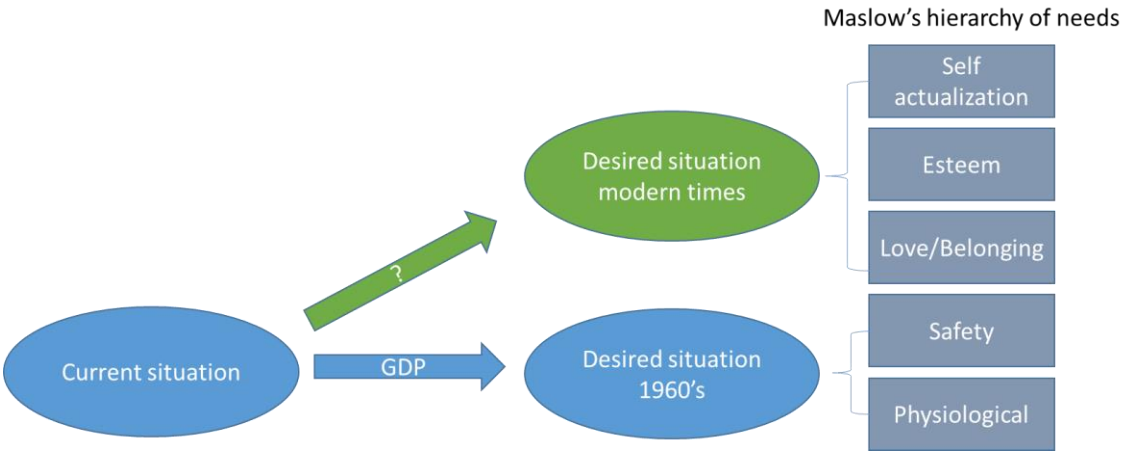

Figure 16 The needs of modern times are different from those in the 1960's when GDP found its predominant use as social welfare indicator. While GDP has led to meeting the lower level needs in the past, a different compass is required for policymakers to address higher level needs.

The general problem context of GDP as described above is too broad to capture into a game. In order to narrow the problem down we focus on policymakers in the Netherlands and divide the problem into three layers: the current situation, the desired situation and the transfer from current to desired situation.

The current situation – Looking at the current situation we identify several sub-questions: How is GDP used by policymakers and how influential is GDP exactly? What is the impact of the misinformation of GDP? To what extent are policymakers aware of the limitations of GDP? Why is GDP still being used despite limitations?

How is GDP used by policymakers and how influential is GDP exactly?
Besides GDP being used by policymakers to measure social welfare, it is also often used to relate other indicators to. An important indicator for the budget and ministry of finance is for example the debt-to-GDP ratio. Similarly, many other indicators are compared relative to GDP (CBS interview).
The influence of GDP can be found in multiple layers of society. National Statistics Institutes invest a lot of resources in calculating GDP (CBS; CPB). In the Europe Union, GDP is used to determine the contribution each member state has to make for the EU. Governmental budgets are determined based on GDP calculations. Mid to long-term policy are all heavily influenced by GDP (Algemene Rekenkamer). Banks and financial markets closely look at predictions of GDP for their actions. Central banks use expected GDP growth in their determination of interest rate policy. In turn, companies are influenced because the investing climate is dependent on the interest rate policy of the central banks. Since GDP growth has such importance at those levels, media pick it up and private spending by citizens by the news stories of economic growth and recession.

How serious is the impact of the (mis)information of GDP?

Two examples were given in the problem context. GDP did not adequately warn for the economic crisis, nor did it take into account climate change.

To what extent are policymakers aware of the limitations of GDP?

At the moment this is an unknown. Interview with policymakers can help to determine this question.

Why is GDP still widely used, despite the criticisms and limitations?

The logic and use of GDP is simple: GDP is summarized into a single number and if that is growing, social welfare is growing. It is also based on "hard" calculations and has the impression of being a very objective indicator.

Alternatives to GDP not well-developed, nor is it a simple task to generate consensus on an alternative. Alternatives that do take into account determinants of well-being are necessarily more subjective in nature and open to debate.

Van den Bergh gives two reasons GDP still used (1) belief that GDP information has relatively little impact on economic reality; (2) GDP still provides useful information. This would suggest that GDP could easily be replaced or supplemented with additional information.

We propose that the situation is more fundamental. Referring back to our framework on transitions we identify two phenomena that play a major role in the widespread usage of GDP: path dependency and entrenchment. Path dependency (Van den Bergh et al., 2006) refers to the mechanism that development of today's social welfare indicator is dependent on historical events. Historical development through World War II, period of industrialization where GDP worked well as an indicator, provided guidance for growth of large economies of today ("Euphoric growth model")

Feedback loop, importance given by politicians, picked up by media, private corporations, investors and citizens (private spending). In turn politicians give GDP more importance in their policies. Targets, budgetary requirements, monetary policy, financial markets adjusted towards GDP. System of policymaking, belief system of society entrenched in GDP regime. Furthermore, part of the entrenchment is that those with formal power to change are invested in the GDP regime. GDP growth results in increased tax revenues, making larger public spending possible.

Problem that we will be looking at is that GDP information is misused as guide to determine long-term policymaking. For this case it is looked at how a game can be developed to facilitate process of transition towards society where guidance of societal progress is taken beyond GDP.

The desired situation – If the current situation with the use of GDP is a problem, then what alternatives or additions should be made? How should they be used within the policymaking context?

Over the last two decades a number of alternative indicators to GDP have been developed as well as many initiatives from important institutions, such as the OECD, UNDP and the European Union.

Table 27 Overview of several alternative indicators to GDP

Initiatives	Description
OECD Better life index	
Human development index	
Gross National Happiness index	

The transfer from the current situation to the desired situation – Is there sufficient backing from actors in positions to make a transfer? If not, how can such a backing be formed? What changes to the system need to be made before a transfer can occur?

A1.2. Why a simulation game?

GDP has grown firm roots over the system and is not easily replaced. A recent revision at the UN level for calculating GDP took over 7 years to be implemented at the Dutch national statistics institute (CBS). People are also used to working with GDP. A simulation game will allow experimentation within a safe environment and allows people to adopt a different perspective. Additionally, a game generates an engaging and fun environment for discussion to take place.

A1.3. Objectives of the game

Ideally a transfer from the current situation to the desired situation is facilitated by the game. However, at present there are still many questions regarding the current situation. At this stage the focus of the game should be to answer as many unknowns as possible in the current situation. Participants of the game should gain better understanding and awareness of GDP, its limitations, and the impact of making decisions based on GDP.

The game should also stimulate discussion on what is then the desired situation. Additionally it should engage the participants

A1.4. Evaluation of the game

The quality of the game should be evaluated by experts from the problem context and experts in game design. It should also be based on comments received from multiple test rounds.

The evaluation of the result of the game is done by comparing different game sessions. The gameplay is also recorded and analyzed for behavior, posture and language.

A checklist of corresponding questions can be found in the Appendix A. These will be partially answered by the initial meetings with CE Delft and partially by using the Delphi technique. This technique involves consulting experts (Sekaran & Bougie, 2010). They will be asked to answer questionnaires in two or more rounds. In the first round they are asked a series of questions after which the contributions are collected, summarized and fed back in a second round questionnaire. Apart from CE Delft a number of others are involved in the background problem of the game. Using the Delphi technique the input from all of them can be acquired.

A2. Phase 2 – Reality, the system analysis

The second phase in the design process is the system analysis. In this phase the relevant elements of the world that is being modelled and the relationships between them are identified. This phase can be seen as an intermediary step in going from reality to simulation game. The purpose of doing a system analysis is to give a detailed description of the problem context. The system analysis will serve as the basis for the rest of the design process and will aid in communication throughout the process.

For complex systems actors often provide a good starting point for the system analysis.

A2.1. Actor analysis

Enserink et al. (2010) have analyzed a number of actor analysis methods and summarized them into the following core steps.

Step 1: Problem formulation

Problem that we will be looking at is that GDP information is misused as guide to determine long-term policymaking.

Step 2: Inventory of actors involved

Table 28 Inventory of various actors involved related to GDP

Actors related to GDP	Actors related to beyond GDP progress
Supranational level	OECD
European Commission	Ministry of Infrastructure and Environment
European Central Bank (ECB)	Planbureau voor de Leefomgeving (PBL)
National level	Sociaal en Cultureel Planbureau (SCP)
Ministry of Finance	"Green" companies
Ministry of Economic Affairs	Developers of social progress indicators
Agencies	Universities
Eurostat	
Centraal Bureau voor Statistiek (CBS)	Media
Centraal Plan bureau (CPB)	NGO's (e.g. Oxfam)
Wetenschappelijke Raad voor het Regeringsbeleid (WRR)	
Algemene Rekenkamer	
Other	
Universities	
Media	
"Vested" companies	
Banks	

Step 3: Mapping formal relations (undocumented)

Step 4: Drafting problem formulations for actors

Table 29 Overview of actors and their perspective on the problem situation

Actors	Interests	Desired situation/objectives	Existing situation and gap	Causes	Possible solutions
Supranational level					
European Commission	Reach 2020 targets on employment, innovation, education, social inclusion and climate/energy				
European Central Bank (ECB)	Maintain price stability and safeguard value of Euro.				
OECD	Improve economic and social well-being				
National level					
Ministry of Finance	Keep Netherlands financially healthy. Fiscal policy				
Ministry of Economic Affairs	Create suitable conditions for entrepreneurs and cooperation with scientists. Build sustainable, entrepreneurial Netherlands.				
Ministry of Infrastructure and Environment					
Agencies					
Centraal Bureau voor Statistiek (CBS)					
Centraal Plan bureau (CPB)					

Planbureau voor de Leefomgeving (PBL)					
Sociaal en Cultureel Planbureau (SCP)					
Wetenschappelijke Raad voor het Regeringsbeleid (WRR)					
Algemene Rekenkamer					
Other					
Universities					
Media					
"Vested" companies					
"Green" companies					
Alternative social progress initiators					

Step 5: Analyze interdependencies

Statistical bureaus worldwide coordinate the calculation of GDP. The definition of GDP is under constant revision. GDP now is already different from the GDP that was calculated 5 years ago. Important herein is that GDP is not a completely fixed and rigid indicator, but it is open to revisions. Radically different alternative social progress indicators do not share the same coordination as GDP currently. The strengths of GDP as an indicator are the ease of use because it is only one number and it is based on "solid" calculations. Most of the alternatives such as Human Development Index (HDI), OECD's better life index (BLI) and Social Progress Index (SPI), combine a number of indicator. They aggregate them into a single number but such an aggregation is very value laden since it involves the weighting of importance of different aspects of the indicator such as health, education or safety. As a result the alternatives are more complex to use compared to GDP. There is also no consensus or European standard for the use of such alternatives. An illustrating quote may be to better deal with the devil you know than the devil you do not. There is still a need for convergence of the work done on the various alternative indicators (Smits et al., 2014)

A bit darker mechanism is that aiming for GDP growth is in the interest of policymakers themselves. This may occur at the larger governmental level, but also at the individual level of policymakers themselves. Budgetary policy and a countries economic health is partially based on the ratio of government deficit to GDP. Additionally, if GDP increases, private spending will increase and therefore tax revenues gained by the government will also increase. This leaves more room for the development of public policy. At the personal level of policymakers they can be accredited with more success.

Another potential mechanism is that public policies for GDP growth favor the wealthy. According to a recent report by Oxfam (2015), around 85% of public policies after the economic crisis in 2008 are actually favoring the wealthiest. The top 1% wealthiest have a lot of influence on policymakers through lobbying and are also influential in shaping public views.

Public perception may also play an important role for the use of GDP. If GDP is widely considered to be an important indicator, actors at all levels will act on it. The importance given by governments and central banks to GDP is picked up by consumers and companies. Their economic actions will thus be influenced by GDP, which in turn puts it back on the political agenda. A positive feedback loop is thus formed. A crucial role is played by the media in the forming of public perception.

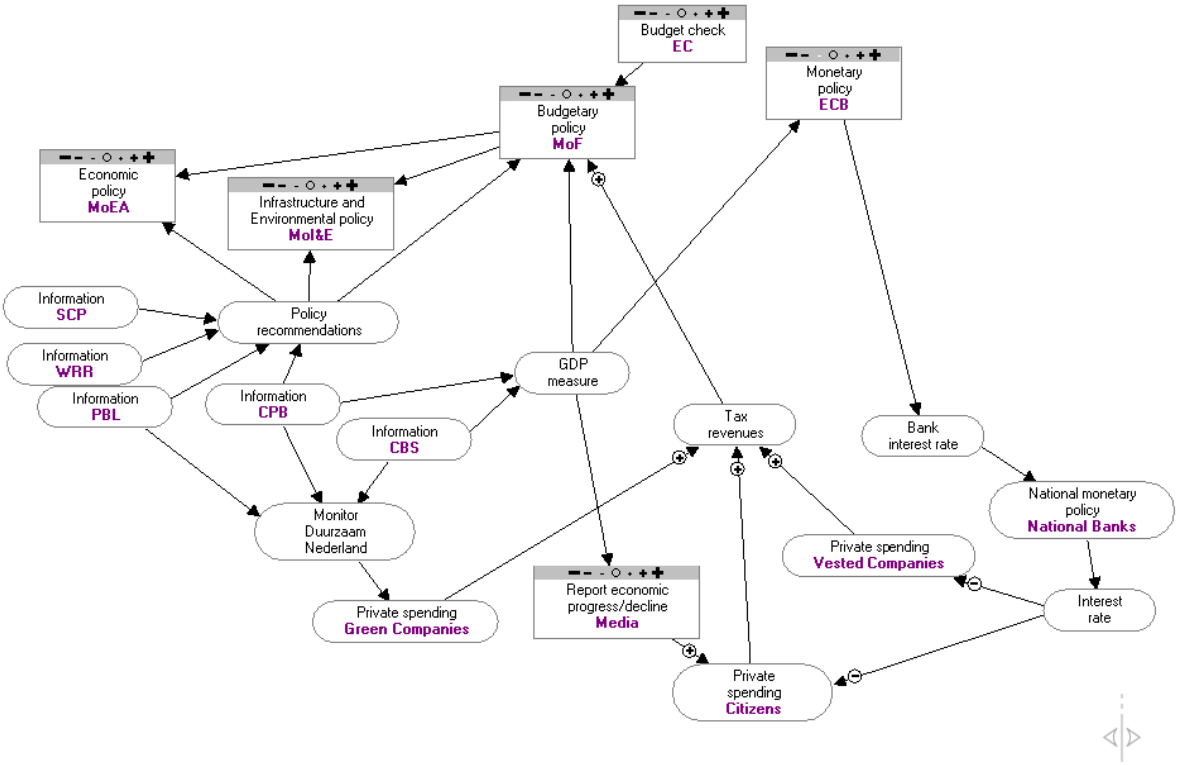

Figure 17 Analysis of actor interdependencies

Step 6: Review problem formulation (undocumented)

A3. Phase 3 – The game design: case study CE Delft

1 The objective of the simulation game

The objective of the game is to tackle problems at the current situation as well as the desired situation. On the one hand, participants of the game should gain better understanding and awareness of GDP: its strengths and limitations, and the impact of making decisions based on GDP. On the other hand, the game is used to test the impact of different indicators and different role descriptions on the behavior of the participants. A simulated version of a GDP indicator and a well-being indicator are tested.

During the debriefing phase, the game provides the basis for discussion on what the desired situation is and what kind of information is required to get there.

2 *The participants*

The game is designed to be played by policymakers. The first big session will be played with a number of former CE Delft employees, working at various institutes across the Netherlands.

3 The scenario

The game takes place on a faraway planet to take the focus away from reality on earth. A group of travellers took a spaceshuttle to explore the universe. They got hit by a meteorite and were forced to make an emergency landing on an unknown planet. During the crash used landing capsules to escape and were split across three different islands. Arriving on the islands, the travelers were treated as gods falling down from the sky by the indigenous people. The indigenous people have a good and steady life. But seeing the magical devices brought in by the travelers, they now turn to wisdom from the gods from the sky for advice on how to develop their civilization further.

4 The objective in the simulation game

The objective within the game is for the players to develop the islands. Based on the decisions the players make, they will be scored. The team that ends up with the highest score wins the game.

5 The macro cycle – focus on objective of the game

Preparation:

-Requires 3 (large) tables to be set up for players to sit around.

-Score forms

-Game board (3 islands)

-Resources (Coins, production, resources, equipment, goods)

-Laptop/computer with excel

Players fill in score form of what factors they find most important in life. This will be kept separate from the game introduction in order to not rouse any suspicions with the players that it is in fact part of the game or game debriefing. It can be framed as being part of the research.

Introduction: They receive an introductory talk about the game and the setting in which the game takes place. A short explanation of the rules are given with explanations of what choices can be made and their in-game impact.

Play: A game session is held where the players can play several rounds of development.

Debriefing: The players receive their initial score forms back in which they indicate what they find important factors in life. This will serve as the basis for the reflection on how the players developed their islands.

Evaluation:

6 The micro cycle – focus on objective in the game

Starting phase – Each player will be divided over the three islands. They will then each receive a role card and corresponding decision/status pad. This role card will contain a job description as well as a personality description. There are 5 roles in the game and each of the roles have 2 decision areas (e.g. Health & Education). The decision they are allowed to take is to decide how much to invest in either of these areas and how much money to ask for these investments. On the decision pad there are 2 areas (e.g. Health & Education) and the player can place money chips on these 2 areas to show how much he will invest in each. On the status pad an indicator is placed on a meter ranging from 1 to 5, showing the current status of that particular area (1 being very bad, 5 very good).

The game is then played in rounds which are set up with the following phases:

Phase 1 - information: At the start of each round, every island will be provided with information on their current scoring.

Island 1 has a personality description of making the island the wealthiest – Receives progress in GDP indicator and is scored based on their GDP.

Island 2 has a personality description of tending to the inhabitants' needs – Receives progress in GDP indicator but is scored based on well-being of inhabitants.

Island 3 has a personality description of tending to the inhabitants' needs – Receives both progress in GDP indicator as well as in well-being indicator and is scored based on well-being of inhabitants.

Besides the general island scoring, each role also receives the current status for their role. For example, the master of health and education receives the status of health and education on the island. This status can range from 1 to 5 (1 being very bad, 5 very good) and is adjusted on the status pad.

P**hase 2 – income/events/rewards:**

The players receive their tax income to make decisions for the round. Any external events or rewards will also take place in this phase. Events or rewards take place depending on an accumulation of the score on your status pad. For example, if you score a 4 in health for 3 rounds in a row you have accumulated a score of 12. This may correspond to the level 1 medical facilities of a field hospital. If you have accumulated a total score of 20 you unlock the academic hospital, which you can place on your island board.

Phase 3 – decision making

The players make their decisions. The master of coin is in charge of finances and can determine the budget of how much each other player gets. Based on their role cards the players can decide to invest in certain developments. For example, the master of culture and trade can decide to invest his budget in either culture or trade.

7 The roles

Master of coin – Personality descriptions:

Island 1 - You are the wisest of the group and entrusted with the

Job description: The master of coin is in charge of finances. Each round he can decide the level of taxes (1-5) and the amount of coins each other master will receive to perform their actions. The level of taxes will determine how much income is generated for the government in the next round.

However, high taxes may also hamper economic growth in the long run with private investment and consumption going down. The master of coin is also finally responsible how much of the treasury goes to the rest of the masters.

Master of production and environment – Personality descriptions:
Island 1 –
Island 2 –
Island 3 –
Job description: You are in charge of managing the production and environment on the island. Production is essential to the survival of the inhabitants as well as development of the economy on the island. Be aware that overproduction strains the resources on your island and can lead to damage to the environment. In order to compensate, you can choose to invest in additional measures to protect the environment.

Master of culture and trade – Personality descriptions
Island 1 – On your trade missions you have learned a great deal about cultures on the planet and you wish to further develop this on your own island as well.
Island 2 –
Island 3 –
Job description. You are in charge of managing trade and the development of culture on the island. Investing in trade relations and routes can bring a boost to the economy of your island. You can also invest in developing the culture on your island. Overflowing your island with culture might distract the inhabitants a bit from their productive activities on the island however.

Master of health and education – Personality descriptions:
Island 1 –
Island 2 –
Island 3 –
Job description: You are in charge of managing the health and education of the people on the island. Healthy people will be more productive and stay employed longer.

Master of safety and employment - Personality descriptions:
Island 1 – You grew up in an orphanage and noticed all around you how difficult it was to find a proper job without the right upbringing. Many of your fellow orphans resorted to a life of crime to survive.
Island 2 –
Island 3 –
Job description: You are in charge of the safety on the island and trying to keep up the employment rate on the island.

8 Events
Resource depletion

Climate change
Uprising due to inequality
Uprising due to unhappiness

9 Rules

10 Other elements

11 Indicators / assessment criteria

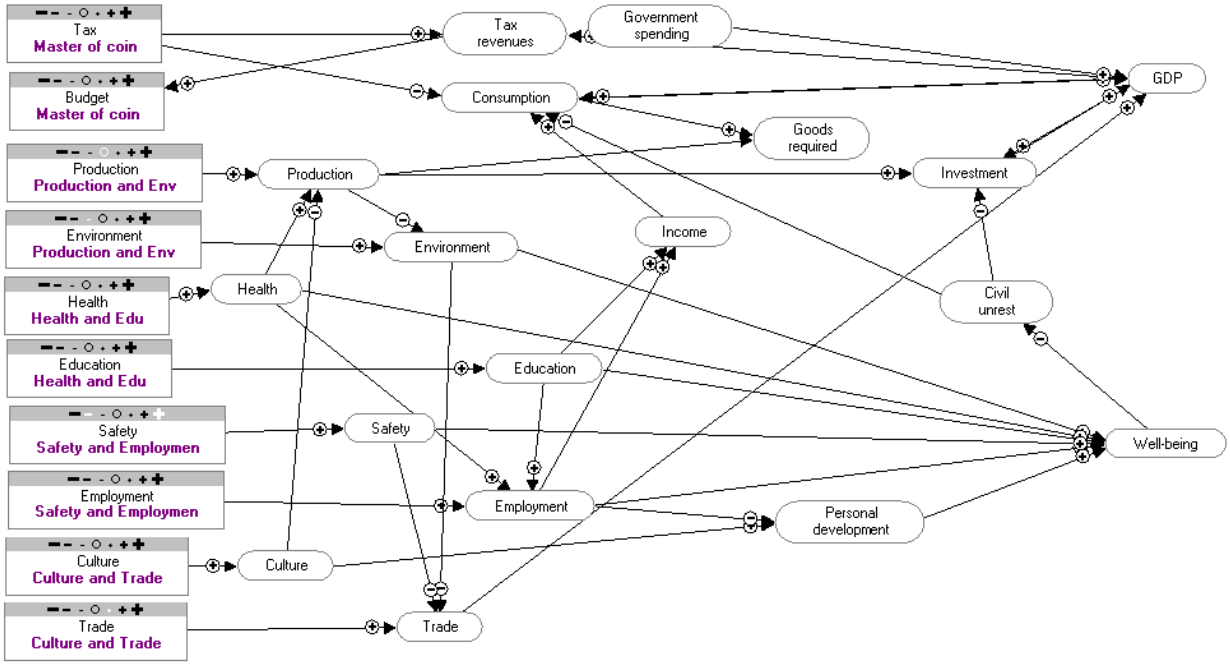

Figure 18 Interdependencies used for roles within the game

GDP indicator

GDP indicator is calculated based on the expenditure approach:

$$GDP = Consumption + Investment + Government\ spending + trade$$

The scoring for island 1 will be done by multiplying GDP by a certain scoring factor yet to be determined.

Well-being indicator

Contains several factors: Environment, health, education, safety, employment, personal development. Based on the status indicators of each of these factors the well-being indicator can be setup.

The scoring for islands 2 and 3 will be done by taking the total accumulated points.

12 Data

13 Tools and paraphernalia

14 Rules for the implementation of the simulation game

Selection of system components

Matrix of system components and gaming elements

Game elements

- Scenario
- Events
- Roles
- Cycles
- Rules
- Decisions
- Data
- Indicators
- Accounting system
- Objects and tools

Choice of game format

Game on paper

Concept game

A4. Phase 4 – The game construction

Undocumented

Appendix B: Summary of list of selected papers for literature review on cases of awareness games

In this Appendix we take a look at several examples of awareness games by others, in order to see what we can learn from current practices on the design of awareness games. We have done so by conducting a literature review, using the guideline by Van Wee & Banister (2016) to ensure proper structure.

B1. Literature review structure and methodology

The aim of the review is to find what can be learned from how awareness games are currently developed. We add value by identifying two critical issues we found within current practices. The scope of the review is limited to games specifically designed for raising awareness, since we are interested in the design process and choices that lead to an awareness game. This excludes games made for a different purpose but that are usable for the purpose of raising awareness. The review focusses on the structure and steps of the game design process followed, the theories or methodologies used to guide the process and the evaluation of the resulting game. Based on our scope and review focus we selected papers with the following criteria: (1) the paper concerns a game that was made with the purpose of raising awareness and (2) the author(s) either developed the game or was/were otherwise intricately connected to be able to describe the design process.

Regarding our search strategy we have used the databases Scopus and Web of Science. Furthermore, based on recommendations by experts we have searched the journal "Simulation and Gaming" and the Games For Change organization for practices from the industry. The keywords "Awareness AND Games" were entered in the fields "Article title, Abstract, Keywords" (Scopus) and the field "Topic" (Web of Science). The Games For Change website was searched for publications related to game design. Using this search strategy we have found 11 papers matching our criteria in the scientific literature. From the publications from the industry we did not find any usable papers as their design process was not accessible. We acknowledge that the found papers do not provide a complete overview of the current practices, but they should be sufficient to form an initial perspective of the state of current practices.

B2. Results of the literature review

The results of the literature review are presented in the table below.

	General info			Game design process			Evaluation		
#	Author (year)	Topic	Game Type		Approach/ method/ theories/ tools used	Structure	Method	Results and validation	Awareness definition
1	Hauge et al. (2014)	Proposal for the development of a game for raising awareness on shared resources for reducing waste within supply chain management (SCM).	Digital business simulation game	Implicit, linear process derived from ordering within the paper	- Identify challenges and barriers for implementing shared resources. -Explore existing available games for SCM and determine shortcomings for own goal. -Adapt existing games to incorporate decision making process surrounding shared resources more realistically. -Prototype using a game engine that allows for several scenarios.	Proposed frame has a clear linear step-wise structure up to prototype stage	-	Game not yet completed	No clear definition given Paper implies that awareness is key to cooperation between stakeholders as well as cooperation in workspace environment.
2	Choo et al. (2013)	Indie game titled *3=3* for raising awareness on disabilities. Game revolves around a team of three characters with different disabilities that have developed different strengths as a result of their disabilities. As a team the three complement one another solving	Digital role playing game	Explicitly listing two design perspectives, yet further information about structure or design choices lacking.	-Build plot and setting for explorative gameplay and emotionally charged situations. -XEODesign “four types of fun”: 1. Easy Fun, connected to exploration, role play, creativity; 2. Hard Fun, conquering challenges and achieving goals;	Unclear what structure was used and in which order. Perspectives were considered	Qualitative and quantitative data collection methods, not further specified.	Game not yet completed	No clear definition given. Paper presents goal of generating political and social awareness

		various problems in the game environment			3. People Fun, social and cooperative aspects of gaming; 4. Serious Fun, evoked when purposeful play impacts players' mindset. -Psychological theory of Bateman and Boon (2006) identifies different gamer types using Myers-Briggs personality types. -Design game elements based on fun and gamer types. -User playtesting	simultaneously			
3	Denning et al. (2013)	Game titled *Control-Alt-Hack*, a modified version of the card game *Ninja Burger*, aimed at raising awareness for cyber security. Game is centered on mission cards that require you to use hacker skill cards to succeed. Cards introduce players to a large number of technologies and security threats.	Physical tabletop card game	Explicit description of game design process	-Determine project goals -Determine target audience -Choose game mechanics: decided to license system from pre-existing game and create new game content. Choice of game related to project goals. -Multiple playtest sessions (n=46) with different audiences resulting in changing card text, modified art and gameplay decision trackers	Clear linear stepwise structure up to prototype game. Followed by cyclical iterations for improvement	Surveys among educators (facilitators) and students (players), both closed and open ended questions	Educators report game played a role in increasing awareness (11 of 14) Students' open ended responses indicate awareness increase (8 of 11) Provided critiques: -Long time to learn and play -Not enough educational value -Not enough fun	No clear definition given. Awareness related goals specified: -Increase understanding of computer security importance -Convey breadth of relevant technologies -Improve understanding of diversity of potential threats
4	Depigny & Michelin (2007)	Game titled *SHRUB BATTLE* aimed at making future rural planners aware of complex relationships	Physical tabletop board game	Game design process description not	-Consider analog vs digital -Base game concepts on system research in reality -Build model representation	Unclear from the description in the paper	Pre-game questionnaire to test knowledge, followed by	Paper reports improved knowledge regarding two	No clear definition given. Awareness related goals specified:

		between landscape dynamics and agricultural practices. Three players pilot a plant species that spread across the board to shape the landscape. A fourth player plays as an animal farmer implementing grassland-management.		explicitly given, some design considerations were reported.	-Game elements built based on simplification requirements of the real system. Additionally, some real life policy measures were chosen to be represented in the game.		theory lesson. Post-game debriefing. Post-questionnaire knowledge evaluation after several weeks	topics (30% and 60% respectively). Awareness of need to involve farmers increased in 30% of students.	-open players' minds to factors involved -discover need to refer to different disciplines -consider issues in a way not accustomed to
5	Dionnet et al. (2007)	Two separate games/simulations developed. First is an RPG titled *TADLA* aimed at raising awareness amongst Moroccan farmers about the scope and contents of a joint irrigation project. Players each own a farm and have to find an agreement to design a joint irrigation project. Second is the TADLA PSE aimed at assisting decision making regarding design and implementation of real irrigation project.	Spread-sheet assisted role playing game; Spread-sheet assisted policy simulation exercise	Explicit diagram of iterative design process. Diagram does not show detailed step procedure however	-Tackle dilemma of determining right level of abstraction. -Two games/simulations developed: role playing game (RPG) and policy simulation exercise (PSE) to address topic at different abstraction levels RPG: -Build (semi-contextual) representation of reality -Prototype built through iterative process of design, test and evaluation with participants and researchers/professionals PSE: -Build environment, based on real data -Base simulation on results and information after RPG	Cyclical process of design, testing and evaluation.	RPG: Briefing and debriefing session PSE: Individual evaluation with participants some time after PSE session	Paper reports that based on observations and debriefing session, the RPG supported valid learning experiences. The PSE results were used to prepare feasibility studies for proposed farmers' projects.	No clear definition given. Awareness related goals implied: -Educational goal of teaching farmers about the scope and contents of a joint irrigation project. -Enhance cooperation between farmers

6	Douven et al. (2014)	Game titled "Shariva" aimed to create awareness and support policy development amongst water and related professionals regarding trans-boundary river basin cooperation. The game introduces trans-boundary issues between two countries Sha (upstream) and Riva (downstream). Players are divided to play roles within these two countries.	Computer simulation assisted role-playing game	Explicit description discussing a specific framework being used with slight adjustment.	Framework developed by Bots and van Daalen (2007) used. -Identify purpose of the game -Identify players -Build representation of context -Roles -Build representation of inter-actor environment -Build technical tools	Linear step-wise structure	Questionnaires, closed questions about game purposes, open questions about game. Pre- and post evaluation on comfortability with certain statements.	Player reported increased awareness and knowledge (4.2 of 5) Pre- and post evaluation highlight specific skills and knowledge differences. Game was part of a several day training workshop, unclear how this affected scores.	No clear definition given. Awareness related goals specified: -apply and analyze MA95 framework -apply conflict resolution approaches -select administrative and technical tools
7	Hansman et al. (2005)	Game titled *SIMULME* aimed at raising awareness on ecological and economic effects of food consumption. Players makes purchases regarding food items representing a typical consumption pattern. After each purchase the effects over 5 years on the countries' ecological and economic situation are shown.	Internet-based simulation game	Explicit mentioning of model basis, however no design process description	-Scientific analyses of relationships in real system used as basis for model system -Five psychological elements considered during design: 1. Role of trendsetter 2. Responsibility for overall system and development 3. Learning by feedback with explanations 4. Photographic illustrations to support emotional aspects 5. Interactive representation of development and state of system	Unclear	215 pupils equally divided between using learning game and standard lecture. Pre- and post questionnaires used	Attitudes concerning nutrition behavior found to be statistically significant more ecologically positive in game group.	No clear definition given. Awareness related goals implied: steering players towards attitude change regarding food consumption patterns.

8	Kiong et al. (2016)	Untitled game aimed at raising awareness for smart grids amongst general public. The game simulates the electricity network in Singapore. Players invest in measures to upgrade the network and gain "smart points".	Tabletop board game	Implicit, no specific game design process description.	-Determine smart grid fundamentals and characteristics. -Build simulated environment within tabletop boardgame -Further design game elements guided by three "persuasive strategies": Simulating experience, personalizing, competition and recognition.	Unclear	Observations during play as well as pre- and post game surveys	Paper reports that the use of "persuasive strategies" was extremely effective in raising awareness among players (n=200). Survey questions and results are not presented however.	No clear definition given. Awareness related goals implied: -Learn about smart grids -Change attitude of players to accept and support smart grid implementation
9	Melthis et al. (2015)	Games under development are a partial-sightedness (PS) and a full-blindness (FB) simulator, created to raise awareness on these visual impairments. The simulators feature a realistic digital 3D world in which the player controls a visually impaired avatar.	Digital 3D simulation, 1st person perspective	Explicitly mentioning design considerations.	-Review existing games and applications that simulate the effects of visual impairment. -Explore game technologies and possibilities -Determine requirements for simulators -Choose technologies for building 3D virtual world -Iterative design process with prototypes for implementation of different visual impairment features	Initial linear structure moving to cyclical process during	Questionnaires (pre and post), observations and interviews	PS simulator showed 20% increase from little awareness to aware (4 of 20), 12 of 20 were already aware. FB simulator vastly raised awareness (6 of 17) and raised some awareness (9 of 17) in players.	No clear definition given. Awareness related goals implied: -Behavioral change of players to be more inclusive for sufferers of visual impairments
10	Ong-Flaherty et al. (2017)	Game titled *BaFa' BaFa'* aimed at raising cultural awareness among students of health professions. Players are divided between two tribes, speaking different languages and having different goals.	Non-computerized role playing simulation game	Implicit, no specific description of game design process, most likely because an existing	-Identify cultural issues in healthcare -Define cultural awareness -Use existing game developed for cultural awareness in US Navy in a different setting with graduate students in nursing and clinical psychology	Unclear	Qualitative measurement in form of a guided debriefing session	Paper presents the emergence of four different themes during debriefing that indicate to an increase in cultural awareness. These are illustrated in the	"Cultural awareness is… the process of identification of culture as a phenomenon, examination of one's own biases and emotions

		Members of each tribe take turns in visiting the other tribe and return to report the experience.		game with very minor or no adjustment				form of participant quotes during debriefing sessions.	against cultural diversity, and exploration of one's own cultural and professional background"
11	Torres & Macedo (2000)	Game titled *Learning Sustainable Development (LSD)* aimed at raising awareness toward environmental conservation and urban development. Players choose cards with practices in order to steer their communities toward sustainable practices. The external environment is created through scenario and event cards.	Tabletop card game	Explicitly mentions several design considerations, however detailed process description is lacking	-Determine core issues for sustainable development -Abstract core issues -Present in accessible and engaging frame -Need for wide applicability leading to choice for a simple medium -Prototyping, testing and revision	Cyclical process of design, test and revision	Debriefing sessions	Observations show participants learning new concepts and factors involved in sustainable development. Participants report strong sense that sustainable development requires cooperation.	No clear definition given. Awareness related goals implied: -Change attitude and behavior concering routine practices -Help people develop skills to apply knowledge

Appendix C: Summaries of existing design frameworks related to awareness games

In this Appendix we show the analysis we have done on existing design frameworks related to awareness games, summarizing the goals of the frameworks as well as their key components.

Table 30 Overview of goals and key components of various existing design frameworks related to awareness games.

Author (year)	Goals	Key components
Ahmad et al. (2015)	Understanding the relationships between game play (rules and regulations), game environment, learning theories, and the subject-matter (learner's achievement to achieve the objective of subject content) embedded in the educational game.	Identification of four major domains to consider and 154 components divided over these domains: Game play (sample components: feedback, activities, challenges, competition, play, etc.) Game environment (sample components: story, problem-solving, visualization, complex scenarios, multimedia, genre, etc.) Learning theories (sample components: flow theory, cognitive load theory, cognitive development, situated learning, etc.) Subject matter (sample components: syllabus, learning outcome, moral building, critical thinking, learning progressions, etc) Paper focusses on subject matter and discusses implicit relationships between components that are supported by literature. These relationships were found by using an interpretive hermeneutic approach, in which Game-based learning experts were consulted. The following 11 relationships were found: 1. Before flow of learning occurs, perception of challenges to match one's skills level with game level to achieve goal, speed of learner to solve an activity and ease of use need to be established. 2. Educational practice and learning can provide fun and instructional practice to the learner. 3. Educational practice should be able interactively designed in order to provide motivational learning for learners. 4. Reflective observations of feedback provide construction of plan to establish complex thinking. 5. Reflective observation of feedback allows discovery of new solutions when learners achieve goals. 6. Assessment technology has collaborative environment to engage and motive learning while assessing their skills with learning outcome 7. Games should indulge learners with assessments to quantify knowledge and abilities. 8. To improve the enforcement of learning objectives and content of a subject by learners, learning and entertainment element must be connected. 9. Learning process combines explicit knowledge, conversations, and reflection of results for learners to construct knowledge. 10. Player's ideal solution is to overcome the challenges with less repetitions of solving.

<table>
<tr><td></td><td></td><td>11. Players meet the challenges through guidance and collaboration throughout the process of solving a task.</td></tr>
<tr><td>Aleven et al. (2010)</td><td>-Precisely specifying educational objectives
-Relating game mechanics, dynamics, and aesthetics (MDA) and principles for instructional design</td><td>-Learning objectives
Assessing
1. Prior knowledge needed to play
2. Expected learning and retention from play
3. Potential transfer from in-game to reality
Use of Bloom’s Revised Taxonomy to assess learning objectives
-MDA Framework
Consider games in three mutually-dependent layers: Mechanics, Dynamics and Aesthetics
Analyse how MDA relate to learning objectives
-Instructional Design Principles
Use of different principles as lenses to use when creating games.
Multi-Media principles, Mayer and Moreno (2003)
Cognitive Tutor principles, Anderson et al. (1995)
Life-Long Learning principles (http://www.psyc.memphis.edu/ learning/principles/)
36 principles of game-based learning, Gee (2007)

Use each of the framework components as focus during brainstorming for initial design. Then check whether ideas also work within other framework components.</td></tr>
<tr><td>Amory (2007)</td><td>Development of a theoretical model to support the development of educational computer games and provide a mechanism to evaluate the use of computer games.</td><td>The model consists of five spaces: Game Space, Visualisation Space, Elements Space, Actor Space and Problem Space.
These spaces contain objects that can be described through abstract interfaces (pedagogical/theoretical components) and concrete interfaces (game design components) They provide a breakdown of the structure and components of games.
<table>
<tr><td>Game space</td><td>Visualisation space</td><td>Elements space</td><td>Actor space</td><td>Problem space</td><td>Social space</td></tr>
<tr><td>Play</td><td>Critical thinkin</td><td>Fun</td><td>Drama</td><td>Puzzlement</td><td>Computer mediated communication</td></tr>
<tr><td>Exploration</td><td>Discovery</td><td>Emotive</td><td>Role models</td><td>Accommodation</td><td>Social network analysis</td></tr>
<tr><td>Challenges</td><td>Goal formation</td><td>Graphics</td><td>Interact</td><td>Assimilation</td><td></td></tr>
<tr><td>Engagement</td><td>Goal completion</td><td>Sounds</td><td>Gestures</td><td>Complex</td><td></td></tr>
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<tr><td></td><td></td><td>
<table>
<tr><td>Narrative</td><td>Competition</td><td>Technology</td><td></td><td>Flow</td><td></td></tr>
<tr><td>Authentic</td><td>Practice</td><td>Backstory</td><td></td><td>Activity-based</td><td></td></tr>
<tr><td>Multiple views</td><td>Storyline</td><td></td><td></td><td>Conflict</td><td></td></tr>
<tr><td>Gender-inclusive</td><td>Plot</td><td></td><td></td><td>Explicit knowledge</td><td></td></tr>
<tr><td>Transformation</td><td>Reflection</td><td></td><td></td><td>Conversation</td><td></td></tr>
<tr><td>Tacit knowledge</td><td>Relevance</td><td></td><td></td><td>Communication</td><td></td></tr>
<tr><td></td><td>Game rhythm</td><td></td><td></td><td>Literacy</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Memory</td><td></td></tr>
<tr><td></td><td></td><td></td><td></td><td>Motor</td><td></td></tr>
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</td></tr>
<tr><td>Arnab et al. (2015)</td><td>Tool to support design as well as analysis and assessment.</td><td>Proposition of the Learning Mechanics-Game Mechanics (LM-GM) model. The model maps learning mechanics to game mechanics based on Bloom’s Taxonomy. The model aims to identify key components, referred to as “Serious Games Mechanics” (SGMs), which combine pedagogical and gaming agendas. SGMs can be seen as finer grain components than game design patterns. The author extracted a list of learning mechanics from literature (Brainerd, 1978; Gagné, Briggs & Wagner, 1992; Keller, 1983; Papert & Harel, 1991) as well as a list of game mechanics (Bellotti, Berta, De Gloria & Primavera, 2009a, b; Connolly, Boyle, Hainey, MacArthur & Boyle, 2012; Järvinen, 2008; Sicart, 2008). These can be found in the table below
<table>
<tr><td></td><td>Learning mechanics</td><td></td><td></td><td>Game mechanics</td><td></td><td></td></tr>
<tr><td>Instructional</td><td>Guidance</td><td></td><td>Behavioral momentum</td><td>Role Play</td><td></td><td></td></tr>
<tr><td>Demonstration</td><td>Participation</td><td>Action</td><td>Cooperation</td><td>Collaboration</td><td></td><td></td></tr>
<tr><td>Generalisation</td><td>Observation</td><td>Feedback</td><td>Selecting</td><td>Tokens</td><td>Goods / Information</td><td></td></tr>
<tr><td></td><td>Question & Answer</td><td></td><td></td><td>Cascading Information</td><td>Cut Scenes / Story</td><td></td></tr>
<tr><td>Explore</td><td>Identify</td><td>Discover</td><td></td><td>Questions & Answers</td><td>Communal Discovery</td><td></td></tr>
<tr><td></td><td>Plan</td><td>Objectify</td><td>Strategy / Planning</td><td>Resource management</td><td>Pareto Optimal</td><td>Appointment</td></tr>
<tr><td>Hypothesis</td><td>Experimentation</td><td></td><td>Capture / Eliminate</td><td>Tiles / Grids</td><td>Infinite Gameplay</td><td></td></tr>
<tr><td></td><td>Repetition</td><td></td><td>Game turns</td><td>Action Points</td><td>Levels</td><td></td></tr>
<tr><td></td><td>Reflect</td><td>Analyse</td><td>Time pressure</td><td>Pavlovian interactions</td><td>Feedback</td><td></td></tr>
<tr><td></td><td>Imitation</td><td>Shadowing</td><td></td><td>Protégé effects</td><td>Metagame</td><td></td></tr>
<tr><td>Simulation</td><td>Modelling</td><td></td><td>Design / Editing</td><td>Movement</td><td>Simulate/ Response</td><td>Realism</td></tr>
<tr><td>Tutorial</td><td>Assessment</td><td></td><td>Tutorial</td><td>Assessment</td><td></td><td></td></tr>
<tr><td></td><td>Competition</td><td></td><td></td><td>Competition</td><td></td><td></td></tr>
<tr><td>Motivation</td><td>Ownership</td><td>Accountability</td><td>Urgent Optimism</td><td>Ownership</td><td></td><td></td></tr>
<tr><td></td><td>Responsibility</td><td>Incentive</td><td>Rewards / Penalties</td><td>Status</td><td>Virality</td><td></td></tr>
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		Using the LM-GM model for analysis can be done by: identifying which learning mechanic and game mechanic should be used in each game situation; describing their relationships and implementation; and showing their dynamic appearance during the game flow of actions.
Bots & Van Daalen (2007)	Developing a conceptual framework for designing games to support policy development for managing natural resources. Help match specific game properties with intended function of the game.	Categorization of policy activities to be supported into 1. Research and analyse 2. Design and recommend 3. Advise strategically 4. Mediate 5. Democratize 6. Clarify values and arguments They argue that depending on the policy activity to be supported, the game properties may have to be designed differently. Specific attention is given to the following game properties: 1. Purpose 2. Insights obtained 3. Players 4. Roles 5. Rewards 6. Representation of physical system 7. Representation of inter-actor environment
Braad (2016)	Discussion of: different ways to organize the design and development process of serious games; various models that support specific design decisions; design patterns for serious games	Categorization of different types of frameworks and design models based on context, processes, making design choices and serious game design patterns. Context – differences in designers and users (e.g. MDA model), differences in audience and purpose Processes – phases and iteration (e.g. ADDIE model), inclusion of research (design-based research), inclusion of user-centered design, integration of disciplines (e.g. game design and instructional design), evaluation, integrated process frameworks Making design choices – motivating focused (e.g. Garris et al.), learning-focused (e.g. ARCS model, Gagné's nine events of instruction, RETAIN model), integrate motivation and learning objectives (e.g. LM-GM model, activity-based model) Serious game design patterns – design vocabulary, idea generation, analysis

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<td>Carvalho et al. (2015)</td>
<td>Present a conceptual model how high-level requirement of serious games can concretely be satisfied.</td>
<td>Activity theory based model of serious games (ATMSG)
Existing methods focus on high-level aspects of games or investigate inner components without clear connection between concrete mechanics and high-level objectives.
Taxonomy development of serious games components:
-Gaming components
-Learning components
-Instructional components
Each divided into
1. Actions
2. Tools
3. Goals

Step-by-step procedure
1. Describe activities
2. Represent game sequence
3. Identify actions, tools and goals
4. Description of the implementation

<table>
<tr><th></th><th></th><th>Intro</th><th>Puzzle</th><th>Ending</th></tr>
<tr><td rowspan="3">Gaming</td><td>Actions</td><td></td><td></td><td></td></tr>
<tr><td>Tools</td><td></td><td></td><td></td></tr>
<tr><td>Goals</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Learning</td><td>Actions</td><td></td><td></td><td></td></tr>
<tr><td>Tools</td><td></td><td></td><td></td></tr>
<tr><td>Goals</td><td></td><td></td><td></td></tr>
<tr><td rowspan="3">Instruction</td><td>Actions</td><td></td><td></td><td></td></tr>
<tr><td>Tools</td><td></td><td></td><td></td></tr>
<tr><td>Goals</td><td></td><td></td><td></td></tr>
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<td>De Freitas et al. (2006)</td>
<td>Evaluation methodology to support the development of specified learning activities in</td>
<td>The paper introduces a framework to help tutors evaluate the potential of game-based learning in their practice. It helps answer common questions such as:
-Which game to select for a specific learning context?
-Which pedagogic approaches to use to support certain learning outcomes and activities?
-What is the validity of the chosen game when using it?

The framework draws from evaluation frameworks that exist concerning learning and new technology. It extends those frameworks by introducing</td>
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	virtual worlds.	diegesis, an element that distinguishes games from many other forms. Diegesis is a term used to denote the world within the "story world", which plays a central role in games. The framework presents four dimensions to be considered by a tutor before using games in their practice: -Context: where play/learning takes place; including macro-level (historical, political and economic factors) and micro-level factors (availability of resources and tools); tutor's own background and understanding; technical support -Learner: age, level of group, learning background, styles, preferences, etc -Diegesis (internal representational world): mode of presentation, interactivity, levels of immersion and fidelity -Processes of learning: methods, theories, models and frameworks used to support learning practice.
Duke & Geurts (2004)	Description for a well-documented design process for the purpose of designing policy exercises.	Design process model for policy exercises consisting of 5 phases with 21 different steps. Phase 1 – Setting the stage -Step 1 Administrative set-up -Step 2 Define the macro problem -Step 3 Define the goals of the project -Step 4 Project objectives/methods employed matrix – is a game appropriate? -Step 5 Specifications – constraints and expectations Phase 2 – Clarifying the problem – focus and scope -Step 6 Defining the system – content, boundaries, interrelationships -Step 7 Displaying the system – create a lucid cognitive map -Step 8 Negotiating focus/scope with client – set a clear target Phase 3 – Designing the policy exercise – creating a blueprint -Step 9 System components/gaming elements matrix -Step 10 Definition of gaming elements -Step 11 Repertoire of techniques -Step 12 Select format -Step 13 Concept report Phase 4 – Developing the exercise – complete rule of ten test runs -Step 14 Build, test and modify prototype -Step 15 Technical evaluation Step 16 – Graphic design and printing Phase 5 – Implementation – ensure proper use by client -Step 17 Integrate exercise into client environment -Step 18 Facilitating the exercise -Step 19 Dissemination -Step 20 Ethical and legal concerns -Step 21 Final report to client
Frank (2007)	Developing a	Pragmatic design approach with three design goals in parallel:

	framework for design of serious games to combine non-entertainment goals with fun and engagement.	1. Create an engaging game – addressing six dimensions characterized by Garris et al.: fantasy, rules/goals, sensory stimuli, challenge, mystery and control 2. Cater for training objective – choices to make regarding scenario, information, relevancy and validity 3. Allow context to influence design decisions – for whom, where and under what circumstances are questions affecting game design. Other contextual factors include time available, analysis of the learners and cost.
Gee (2007)	Describe what we can learn from the learning principles incorporated in good games	Learning principles incorporated in games. Description of what makes good games, they: -give information on demand and "just in time" -put information in context, make clear the meaning of information and how it applies -operate at the outer and growing edge of player competence, challenging but do-able -allow players to be producers and co-create the game world -have initial levels with problems that allow players to form good generalizations for solving more complex problems -create "cycle of expertise" -engage players in "action at a distance" -create collaboration using different, but overlapping set of skills, in massive multiplayer games players
Hunicke et al. (2004)	-Develop common framework to decompose, study and design broad class of game designs and game artifacts	MDA framework formalizes games and game design in components. Game components: Rules -> System -> "Fun" Game design counterparts: Mechanics -> Dynamics -> Aesthetics Mechanics: Particular components of game at level of data representation and algorithms Dynamics: Run-time behaviour of mechanics acting on player inputs Aesthetics: Desirable emotional responses evoked in player when interacting with the game system (e.g. Sensation, Fantasy, Narrative, Challenge, Fellowship, Discovery, Expression, Submission) Components of MDA framework can be used as lenses on how to view a game. Each component can be analysed separately, but they are causally linked. Possible use of framework: 1. Define aesthetic goals for design (e.g. challenge) 2. Determine game dynamics that can achieve those goals (e.g. time pressure) 3. Design game mechanics to achieve those dynamics Test, tune and iterate the process.
Ibrahim & Jaafar (2009)	- Produce a framework in	The EG framework calls for integration of game design and pedagogy. The authors analyse several frameworks that have been developed, that combine expertise in game design and pedagogy:

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<td>educational games design for the development of games for higher education.</td>
<td>-Enhance game based learning (Hirumi & Stapleton, 2008)
-Adaptive Digital Game-based Learning Framework (ADGL) (Tan et al., 2007)
-Three Layered Thinking model (Fong & Sheng, 2008)
-Experiential Gaming Model (Kiili, 2005)
-EFM model (Song and Zhang, 2008)

By analysing these frameworks, the authors suggest n framework that breaks down educational game design into the following components:

1. Game design
-Usability (satisfaction, efficiency, effectiveness)
-Multimodal (multimedia and interaction)
-Fun (Challenge, clear goals, uncertain outcome, self esteem)
2. Pedagogy
-Learning Outcomes (Bloom’s Taxonomy)
-Motivation Theory
-Self-learning
-Problem solving
3. Learning Content Modelling
-Syllabus Matching
-Scaffolding</td>
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<td>Kelle et al. (2011)</td>
<td>-Reduce effort for designing educational (learning) games
-Help determine right balance between good game elements and learning</td>
<td>The methodology is a mapping procedure of matching game design patterns to learning functions, in order to find what game elements to add for a certain learning purpose. The game design patterns are drawn from work by Björk & Holopainen (2004), while the learning functions are identified by Shuell & Moran (1996). The methodology aims to connect the two through pedagogical frameworks or taxonomies. Following the identification of these components, experts were consulted to link them. An excerpt of the results can be found in the table below.

<table>
<tr><th>Learning function</th><th>Underlying taxonomy elements</th><th>Game design pattern class</th></tr>
<tr><td>Prior knowledge activation</td><td>Gagné’s instructional event of retrieval</td><td>Goals patterns (e.g. reconnaissance)</td></tr>
<tr><td>Motivation</td><td>Keller’s ARCS model</td><td>Various patterns, mostly score related (e.g. rewards)</td></tr>
<tr><td>Attention</td><td>Keller and Gagné</td><td>Game elements patterns (e.g. surprises, clues)</td></tr>
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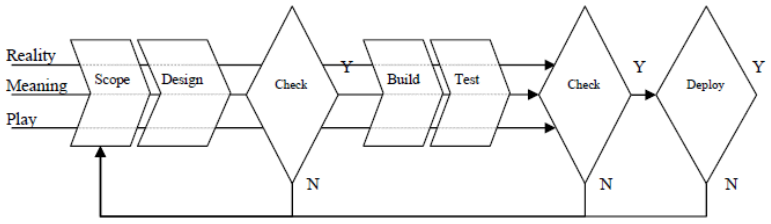
		Expectation	Gagné's instructional event of expectancy	Goal related patterns (e.g. predefined goals, narrative patterns, anticipation)	
Kiili (2005)	Providing a model that integrates educational theory and game design aspects	Experiential gaming model based on experiential learning theory, flow theory and game design. Serves as a link between educational theory and game design. Based on factors contributing to flow experience as described by Csikszentmihalyi (1975). Computer-mediated flow studies distinguishes the following flow stages: Flow antecedents – focused attention, clear set of goals, immediate and appropriate feedback, potential control, a perception of challenges that are matched to the person's skills, playfulness, speed and ease of use Flow experience – Merging of action and awareness, concentration, a sense of control over activity, time distortion and telepresence. Flow consequences - Increased learning, exploratory behavior, acceptance of information technology and perceived behavioral control Flow activities can be described by three components: person, task and artifact. All three of which should be taken into account when designing games. Educational games should provide students with challenges so that flow experience is possible. This requires balancing the difficulty with the skill the player possesses. An experiential gaming model is presented, linking gameplay with experiential learning in order to facilitate the flow experience. The model consists of an ideation loop, an experience loop and a challenge bank. The operational principle of the model can be seen as a human vascular system. Challenges form the heart of sustaining motivation and engagement. The ideation loop describes the player generating solutions divided into preinvative (unstructured, without considering system constraints) idea and idea generation. The experience loop consists of active experimentation, followed by reflective observation which may lead to schemata construction. The game should provide clear goals and appropriate feedback to facilitate the flow experience. The model is not a means to the whole game design project, several important issues are mentioned such as: storytelling, game balance and optimizing cognitive load.			
Kiili et al. (2014)	-Facilitate analysis of educational games -Provide design support for	Framework for analysis and design support of educational games. Foundation based on flow theory. Framework links educational theory and game design. User experience -Users -Artifact -Task Cognitive load theory -Intrinsic cognitive load			

	game developers	-Extrinsic cognitive load Flow framework Flow state -Concentration -Intrinsic rewards -Loss of self-consciousness -Time distortion Flow antecedents -Playability -Clear goals -Challenge -Sense of Control -Feedback Lenses for game design 1. Lens of sensing mind 2. Lens of processing mind 3. Lens of integrating mind 4. Lens of relating mind 5. Lens of transferring mind
Kortman & Hartevel d (2009)	Developm ent of an agile game design process in order to reduce game developme nt project cost and time.	Development process model based on agile software development. The model describes an iterative design process consisting of five phases (Scope, Design, Build, Test and Deploy) with an intermediate check as well as an evaluative check.  At the same time the model draws on Triadic Game Design perspective where the components of Reality, Meaning and Play should be considered and balanced throughout the process.
Mitgusc h & Alvarado (2012)	-Build assessmen t tool to analyse the impact of serious games and assess the quality of	The author reports that publications on serious game evaluation and assessment tools are rare, with three exceptions: -Design, play and Experience Framework (Winn) Breakdown in four elements: Learning, Storytelling, Game play and User experience. -Serious Educational Game Assessment (Annetta & Bronack) Focus on thirteen elements: Prologue, Tutorial/Practice Level, Interactive Feedback, Identity, Immersion, Pleasurable

	their design.	Frustration, Manipulation, Increasing Complexity, Rules, Informed Learning, Pedagogical Effectiveness, Reading Effectiveness, and Communication. -Key criteria for Game Design (Sanchez) Focus on seven elements: Motivation–Competence, Motivation–Autonomy, Motivation-Relatedness, Content, Freedom, Rules & Feedback, Mistakes, Failure & Emotional Aspects and Game Integration Mitgusch critiques the aforementioned tools with the lack of integration of the purpose of the game and intention with which it was designed. They also do not provide a holistic view for assessment, but focus only on different elements of a game. The SGDA framework is centred around the purpose of the game and describes 5 other core components: 1. Content/information 2. Fiction & narrative (Characters, plot) 3. Mechanics (Learning curve, rules, goals, rewards, verbs) 4. Aesthetics & graphics (Setting, visualization) 5. Framing (Play literacy, topic, audience) These components can be used to decompose a game into design elements. These design elements are then further assessed for whether they present a coherent and cohesive game system that should relate to the game's purpose.
Peters & Van de Westelaken (2014)	Elaboration of design process applied in practice, based on Duke & Geurts (2004) with minor adaptations.	Design process model consisting of 4 phases and 10 steps. Essentially corresponding to structure and phases of design process as published by Duke & Geurts (2004). Phase 1: The design specifications -Step 1 Intake: Consultation with client -Step 2 Specifications of the design: Problem background, goals, design process, general considerations, elements of the game, use of the game Phase 2: System analysis -Step 3: System analysis: elements (process phases, information and knowledge, concepts, actors) and relationships between elements (responsibilities, exchange of resources and knowledge, causal relationships) Phase 3: The game design -Step 4: Selection of system components -Step 5: Matrix of system components and gaming elements (Scenario, events, roles, cycles of play, rules, decisions, data indicators, accounting system, paraphernalia) -Step 6: Choice for game format -Step 7: Game on paper Game design part has an iterative nature.

		Phase 4: Game construction and transfer to client -Step 8: Construction of simulation game -Step 9: Test and improve -Step 10: Transfer to the client
Rooney (2012)	Development of a theoretical framework for serious educational games by integrating theories from pedagogy and game design as well as the impact of concepts of fidelity on learning and engagement.	Triadic theoretical framework for serious game design arguing to balance play, pedagogy and fidelity. Review of key literatures and associated challenges. Pedagogical underpinnings – Most pedagogical theories rest on constructivist principles, the epistemological assumption that knowledge and skills are constructed by learners as attempt to make sense of experiences. A key aspect within constructivism is the importance of an "authentic" learning environment. Three key constructivist theories highlighted: -Situated learning – Situated learning theorists claim that knowledge cannot be abstracted from the situation in which it is learned, it is inherently situated. According to this perspective, learning can therefore only take place by participating and interacting within communities of practice. Games can allow players to participate in a virtual community of practice. A key issue here is whether knowledge/skills learned in the virtual world can be transferred to a real-life scenario. Research has shown several factors of influence: 1. Similarity between the two situations increases likelihood of transfer 2. More thorough or meaningful learning increases likelihood of transfer (understanding as opposed to memorization) 3. Developing critical skills (e.g. problem-solving, decision-making) can overcome transfer problems 4. Transfer is enhanced when learners reflect on the potential for transfer during learning process 5. Debriefing on links between gaming environment and real life enhances likelihood of transfer -Problem-based learning Shift from the focus of teaching to learning based on active participation in problem-solving. Key features: -Curriculum constructed entirely around problems -Role of tutor becomes one of facilitator/coach, scaffolding plays an integral part of learning -Authenticity and contextuality are important Games provide extensive opportunities for scaffolding as well as authentic and immersive representations of real-life problems. Challenges lie in a number of areas: -the creation of authentic problems/scenarios, particularly for different groups or needs -for learners to apply knowledge and skills in different contexts, since problems are domain-specific. -PBL requires self-directed learning, which some students may find difficult

-Experiential learning
Learning is seen as a process whereby knowledge is created through the transformation of experience. Kolb's (1984) work central in the field which describes a cyclical process of four stages: concrete experience, observations and reflections, formation of abstract concepts & generalisations, testing implications of concepts in new situations. The model has been subjected to criticisms/elaborations:
-take into account different types of experiences (episodic vs lifelong experience)
-social interaction not taken into account
-limitations of individual reflection, it may result in false conclusions

Gaming can provided new opportunities for experiential learning in virtual environments. Also experiences that may be inaccessible in the real world. Authenticity is therefore important, however high-fidelity gaming environments can also lead to cognitive overload.
Challenges lie in:
-balancing between authenticity and simplicity
-maintaining an appropriate level of challenge
Game play underpinnings – theories of engagement, motivation, flow and immersion
Motivation – Intrinsic motivation more effective in learning than extrinsic motivation
Flow – Csikszentmihalyi's theory and related expansions to digital worlds
Immersion – Various conceptualizations of immersion presented

Relating theories of gameplay to design. Researchers have found different features of games to be important factors to engagement and immersion (see Table below).

Study	Game features
Malone (1981)	Fantasy (pleasurable content), control, challenge, curiosity, collaboration, competition
Bowman (1982)	Clear task, identifiable roles and responsibilities, player choice, balance between player skills and challenges
Presnky (2001)	Clear rules, continuous challenge and competition, clear goals and objectives, direct and instant feedback, immersive story line
Garris et al. (2002)	Fantasy, rules/goals, sensory stimuli, challenge, mystery, control

		<table><tr><td>Sweetser and Wyeth (2005)</td><td>Concentration, challenge, skills, control, clear goals, feedback, immersion, social</td></tr><tr><td>Dumbleton (2007)</td><td>Engaging narrative, graduated challenge, consistent game world, intuitive interface, player agency, clear feedback</td></tr></table> Dickey (2005) provides a triadic framework for design strategies for engagement in contemporary games, comprising of: player positioning, narrative and interactive design. -Player positioning refers to player placement within the game world (e.g. 1st person vs 3rd person perspective) -Narrative in game design is part of an ongoing debate. Proponents claim it to create more engaging play, whereas opponents argue that it detracts from interactivity. Some designers view game as a frame for a narrative co-authored by interaction of the player and the game. This is an important point for game design, where players should be in control of the narrative through game play choices, in order to engage them. -Interactive Design Three key points regarding interaction: -Physical representations of characters and dialogue impact immersion, since it affects how the player identifies with the character. -Interaction of player and game combined with consequent feedback is crucial to player engagement and motivation. Mechanisms facilitating such interactions are referred to as “hooks”. Hooks can be classified into: action hooks, resource hooks, tactical/strategic hooks and time hooks. -Game setting (e.g. game world appearance, role of time, evoked emotions) is an important factor -Fidelity in serious games From a pedagogical point of view, authenticity and high levels of fidelity are important for providing an effective learning experience. Thus it seems to suggest high levels of fidelity in games to be desirable, however the relationship between fidelity, engagement and learning is not so simple. Near-realism visual seems to trigger higher expectations and thus decrease tolerance for inaccuracies or deviations. It is argued that psychological immersion (through good game play and narrative) is more important. The quality of immersion depends more on believability and consistency in the game world rather than true-to-life realism. Also in terms of learning, higher levels of fidelity may not lead to maximization of learning due to cognitive overload. Game design should therefore focus on relevant aspects of reality to the educational task. Determining those elements can be difficult to fit with play elements however.
Serrano-Laguna	a methodolo	Learning analytics and Educational Data mining with Game Analytics Inferring learning outcomes based on non-disruptive tracking.

et al. (2017)	gy for assessing serious game effectiveness based on non-disruptive in-game tracking	Methodology targets two different phases: (1) during design and implementation; (2) during its validation and deployment Design and implementation Game mechanics should fulfill two requirements: -learning mechanics are mapped to game mechanics -gameplay produces learning outcome observables The methodology introduces each learning goal in a game design pattern consisting of 3 phases. 1. Strategy – Introduction to the learning goal. The player receives information on the challenge behind the learning goal and starts identifying ways to tackle it 2. Practice – Players start to apply knowledge from the previous phase. In this phase initial observables can be collected to estimate their initial knowledge 3. Mastery – Players are required to prove having acquired the intended knowledge. In this phase final observables can be collected. Learning outcomes and game effectiveness can be measured through comparing measured observables to a set threshold. Validation and deployment Domain experts and a sample of target population play the game, yielding preliminary results. These can be used in an iterative process to improve a serious game, ranging from changing game mechanics of a learning goal to changing calculation of learning outcomes.
Starks (2014)	-Create a guideline for designers to create games for learning and behavioural change	The framework is based on successful use of Social Cognitive theory to create video games to create positive behaviour outcomes and successful use of theory of multiple intelligences to create engaging learning experiences. The framework aims to combine these theories with game elements to create a unified model to guide game designers. Social cognitive elements for behavioural change (Bandura, 2006) used: -Knowledge -Self-efficacy -Goals -Outcome expectations -Encouragement -Barriers Multiple intelligence elements (Gardner, 1983) used: Graphics; Music; Physical movement; Humor; Space; Narrative; Logic; Nature; Relationship; Math; Language; Personal reflection Enjoyment process elements (Gee, 2003; Prensky, 2001; Squire, 2006) used: Engagement <-> Challenge <-> Flow <-> Persistence <-> Mastery

<table>
<tr><td></td><td></td><td>The framework identifies the use of these various elements to be used for analysing games or game design.</td></tr>
<tr><td>Suttie et al. (2012)</td><td>Making it easier to produce fun and pedagogically effective serious games.</td><td>The author presents a list of game mechanics found in successful Serious Games and learning mechanics that can be related to each other through Bloom’s Taxonomy. Below is an excerpt of the table.

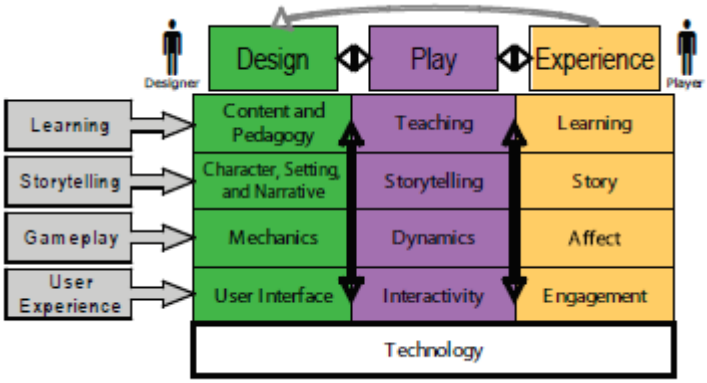
<table>
<tr><th>Game mechanics</th><th>Thinking skills</th><th>Learning mechanics</th></tr>
<tr><td>Design
Planning
Ownership</td><td>Creating</td><td>Accountability
Ownership</td></tr>
<tr><td>Resource management</td><td>Evaluating</td><td>Motivation
Incentive
Reflect</td></tr>
<tr><td>Feedback
Meta-game</td><td>Analysing</td><td>Experimentation
Observation</td></tr>
<tr><td>Time Pressure
Progression
Competition</td><td>Applying</td><td>Demonstration
Simulation
Action</td></tr>
<tr><td>Tutorial
Questions and answers</td><td>Understanding</td><td>Participation
Objectify</td></tr>
<tr><td>Information
Behavioural momentum
Story</td><td>Retention</td><td>Discover
Explore
Repetition</td></tr>
</table>

The framework can be used to find Serious Games Mechanics that have proven successful for implementation of specific educational mechanisms in future Serious Games.</td></tr>
<tr><td>Warmelink et al. (2016)</td><td>Development of a framework for integrating validation into the game design process.</td><td>The framework proposes validation of games to be integrated throughout the game design process, instead of after the game is (almost) completed. The framework is based on an iterative approach to game design, with three fundamental phases: design, prototype and validate. It incorporates the concept of design fidelity – the proximity of a design to the envisioned final product. The framework identifies four levels of design fidelity:
-Specifications level – basic requirements for the final design
-Concets level – grand ideas for the game experience
-Prototypes level – consists of several steps of design fidelity from for example a paper prototype to a digital prototype
-Integrations level - the highest level of design fidelity where the product is integrated into context of use

These design fidelity levels are then related to validity types (content, face, construct, concurrent, predictive) to propose a set of tools for game designers during the validation phase of the iterative design process.</td></tr>
</table>

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>Design fidelity level</td><td>Validity type</td><td>Validation tool</td></tr>
<tr><td>Specifications</td><td>Content validity</td><td>1. Design requirement framework
2. Subject matter check
3. SMART goal definition check</td></tr>
<tr><td>Concepts</td><td>Face validity</td><td>4. Specifications check
5. Applied game design framework</td></tr>
<tr><td>Prototypes</td><td>Construct validity</td><td>Same as concepts level, plus:
6. Playtest, with at least an outcome variable measurement</td></tr>
<tr><td rowspan="2">Integrations</td><td>Concurrent validity</td><td>Same as prototypes level, plus:
7. Quasi-experiment or randomized controlled trial</td></tr>
<tr><td>Predictive validity</td><td>8. Stealth assessment – behavioral data gathering and analysis</td></tr>
</table>
</td></tr>
<tr><td>Wenzler (1997)</td><td>Description of five step design process used in developing a game, based on experiences</td><td>Five step game design process:
1. Development of design specifications
-Interactive process, generally including client
-Defining problem background: boundaries, main issues, suitability of game
-Clarifying objectives
-Defining model of reality: existing vs future, alternatives, level of abstraction
-Clarifying issue of participants
-Address structure of exercise: duration, style (group dynamics, processes, holistic system view), organisation (sequential, fixed, flexible)
-Future implementation
-Design process issues: client contact person, time schedule, financial means, evaluation
2. System analysis of problem, development of conceptual model of problem environment
-Actor analysis (needs, objectives, etc)
-Identify main relationships between actors, processes within relationships, flows within processes
-Translate into conceptual model (qualitative and quantitative aspects)
-Evaluate conceptual model (right complexity, level of abstraction, validity, applicability, consistency, quality of presentation)
3. Transformation of conceptual model into gaming model
-Select components of conceptual model</td></tr>
</table>

		-Development of system components / gaming elements (roles, rules, scenarios, events, sequence of activities) matrix. -Iterative process of filling in cells of matrix -Clustering of information in concept report -Review and evaluation of concept report: comparison with design specifications, consistency of interpretation and synergy between gaming elements. 4. Development of prototype -Iterative and creative process -Transform concept report gaming elements to physical gaming elements -Test elements as well as totality -Incremental design modification and implementation -Formal evaluation of content, material and facilitation requirements 5. Development and implementation of final product -Address remaining client concerns -Develop final gaming kit and necessary materials
Westera et al. (2008)	-Reduce design complexity of serious games -Develop set of design principles to serve pedagogical goals for higher education	The framework provides a shared vocabulary for games basic components and interrelationships Its main focus is on a subset of games, scenario-based games. The framework is divided into three different levels: 1. Conceptual level Educational game environment consists of four subsystems: -Game play world (Critical feature for design) -Learner world -Teacher world -Game management world The game play world is considered as the most critical feature for design and is thus the primary focus. Games consist of static and dynamic parts. The static game environment is explained using a spatial metaphor. Locations are the primary building blocks. Different locations may provide access to tools, resources, fellow players; cover abstract entities (e.g. pages, table cells, other representations); contain various types of objects. Navigation to various locations determined by rules. Dynamics of the game consist of the state changes of various game components. These are governed by underlying rules in the game world (game logic) and triggered by either player actions or internal system triggers. 2. Technical level The technical level describes a tooling system allowing game development and implementation. Essential features should include: -Location builder -Object builder -Role builder -Scenario builder

		3. Practical level Further design principles are given to reduce game design complexity in different categories. 1. Reducing structural design complexity -Option width rather than depth -Shallow distracters -Closures -Parallel task execution 2. Reducing feedback design complexity -Strategic performance feedback -Including peer feedback 3. Reducing representation design complexity -Credibility more important than realism or authenticity -Authenticity of content more critical than authenticity of representation
Winn (2009)	Presenting a formal approach to game design in order to better realize the potential of serious games.	Design, play and experience framework Three different perspectives in play: -Academic perspective (pedagogy, communication theory etc), focus on various theories -Content expert perspective, focus on given subject matter -Game designer perspective, focus on creating engaging and entertaining game play Overlap between these is dubbed the heart of serious game design. DPE framework as expansion of MDA framework Language to discuss design, methodology for analysis of design and process to design a serious game for learning. At the base it is an iterative design process between design, play and experience. The process consists of four layers: learning, storytelling, gameplay and user experience.  In the learning layer the designer designs content and pedagogy, (hopefully) resulting in a teaching experience leading to a set of learning outcomes. Example of pedagogical theory to use is Bloom's taxonomy. Storytelling layer has two perspectives, the designer's perspective (setting, character design, narrative) and the player's perspective (experience, player interaction).

		Gameplay layer, mostly corresponding to MDA framework, where "Aesthetics" is renamed to "affect". User experience layer, the surface layer from the perspective of the player. Layers are influenced by each other and grounded on technology used to build the serious game on.

Appendix D: Axial coding process on entertainment game design industry best practices

In this Appendix we present the extensive results of the coding process as was conducted in section 2.2.

D1. First phase of coding process – full results

In this section we present the first phase of the coding process, which displays the full results of the coding process for each of the game design literature sources that were analyzed.

D1.1. Adams & Rollings (2007)

1. Game elements
    a. Play
    b. Pretending
    c. Goal
    d. Rules
        i. Semiotics
        ii. Gameplay
            1. Challenges
            2. Actions
            3. Fairness
        iii. Goals
        iv. Termination condition
        v. Metarules
2. Entertain
    a. Gameplay
        i. Fun
        ii. Challenges
            1. Hierarchy
                a. Atomic
                b. Sub-missions
                c. Missions
                d. Goal completion
            2. Type
                a. Explicit
                b. Implicit
                c. Intermediate
            3. Difficulty
                a. Skill
                b. Stress

c. Absolute difficulty
iii. Actions
iv. Saving
b. Aesthetics
c. Harmony
d. Storytelling
i. Good story
1. Credible
2. Coherent
3. Dramatically meaningful
ii. Story type
1. Interactive
2. Linear
3. Non-linear
4. Emergent
iii. Advancing plot
1. Series of challenges
2. Journey
3. Drama
e. Risks and Rewards
f. Novelty
g. Learning
h. Creative and expressive play
i. Self-defining play
1. Functional attributes
2. Aesthetic attributes
ii. Creative play
1. Constrained creative
2. Freeform creative
iii. Storytelling play
i. Immersion
i. Tactical immersion
ii. Strategic immersion
iii. Narrative immersion
j. Socializing
i. Multiplayer local
ii. Networked play
3. Design components and processes
a. Player-centric design

i. Entertain
ii. Emphathize

b. Core mechanics
    i. Functions
        1. Internal economy
        2. Active challenges
        3. Player acception
        4. AI
        5. Switch game mode
        6. Trigger storytelling engine
    ii. Key concepts
        1. Resources
        2. Entities
            a. Simple entity
            b. Compound entity
            c. Unique entity
        3. Mechanics
            a. Relationships
                i. Numeric
                ii. Symbolic
            b. Events
            c. Processes
            d. Conditions
    iii. Internal economy
        1. Sources
        2. Drains
        3. Converters
        4. Traders
    iv. Feedback loops
        1. Mutual dependencies
        2. Dead lock
    v. Equilibrium
        1. Static
        2. Dynamic
    vi. Gameplay
        1. Challenges
            a. Passive
            b. Active
        2. Actions

            a. Player
            b. Data
        vii. Design
            1. Goals
                a. Simplicity
                b. Elegance
                c. Patterns
            2. Revisit design work
                a. Nouns
                    i. Entities
                    ii. Resources
                b. Verbs
                    i. Actions
                    ii. Mechanics
c. User interface
    i. Player-centric design
    ii. Design process
        1. Gameplay modes
        2. Screen layout
        3. Feedback elements
d. Structure
    i. Gameplay modes
    ii. Shell menus
e. Design stages
    i. Concept stage (Linear)
        1. Concept
        2. Audience
        3. Progression
        4. Player role
        5. Fulfilling dream
    ii. Elaboration stage (Cyclic)
        1. Primary gameplay mode
        2. Protagonist/Character
            a. Appealing
            b. Harmonious
            c. Credible/Identifiable
        3. Game world
            a. Physical dimension
                i. Spatial

        ii. Scale
        iii. Boundaries
    b. Temporal
    c. Environmental
        i. Cultural context
        ii. Physical surroundings
        iii. Detail/Style
    d. Emotional
    e. Ethical
4. Core mechanics
5. Additional modes
6. Level design
    a. Universal level design
        i. Level
            1. Tutorial
            2. Pacing
            3. Resource management
            4. Avoid non-sequitur
        ii. Player
            1. Short-term goals
            2. Reward
                a. Risk vs reward
                b. Skill
                c. Reward large, punish small
        iii. AI
        iv. Difficulty
    b. Genre specific
    c. Layout
        i. Types
        ii. Atmosphere
    d. Pacing
    e. Design steps
        i. Planning
        ii. Prototyping
        iii. Review
        iv. Refinement and lock-down
7. Story
    a. Game length
    b. Characters

c. Degree of realism
d. Emotional richness

8. Build
9. Test
10. Iterate

iii. Tuning stage (Linear)

1. Small adjustments
2. No new features

f. Balancing

i. Characteristics

1. Meaningful choices
    a. Dominant strategies
        i. Transitive relationships
            1. Shadow costs
            2. Upgrading
        ii. Intransitive relationships
        iii. Orthogonal differentiation
2. Chance
    a. Risk vs reward
    b. Player action
        i. Use odds
        ii. Decide risk
3. Fairness
    a. Symmetry
    b. Asymmetry
    c. Adequate information
4. Comeback mechanism
    a. Controlling positive feedback
5. No stalemate
6. Managing difficulty
    a. Skill
    b. Stress
    c. Difficulty
        i. Absolute difficulty
        ii. Relative difficulty
        iii. Perceived difficulty
    d. Flow
        i. Difficulty progression

D1.2. Fullerton (2008)

1. Playcentric design
    a. Player experience
    b. Prototyping
    c. Playtesting
    d. Iteration
2. Formal elements
    a. Players
        i. Roles
        ii. Number of players
        iii. Interaction patterns
        iv. Invitation
    b. Objectives
        i. Capture
        ii. Chase
        iii. Race
        iv. Alignment
        v. Rescue or escape
        vi. Forbidden act
        vii. Construction
        viii. Exploration
        ix. Solution
        x. Outwit
    c. Procedures
        i. Methods of play
        ii. Actions
    d. Rules
        i. Objects
        ii. Concepts
        iii. Restricting actions
        iv. Determine effects
    e. Resources
        i. Utility
        ii. Scarcity
    f. Conflict
        i. Obstacles
        ii. Opponents
        iii. Dilemmas
    g. Boundaries
        i. Magic circle
        ii. Physical
        iii. Conceptual

- h. Outcome
  - i. Uncertainty
  - ii. Measurable
  - iii. Zero vs non-zero sum

3. Engagement/Dramatic elements
   - a. Challenge
     - i. Skill
     - ii. Flow
     - iii. Clear goals
     - iv. Feedback
     - v. Paradox of control
   - b. Play
     - i. Nature of play
       1. Competitve
       2. Chance-based
       3. Make-believe
       4. Vertigo
       5. Rule-based
       6. Free-form
     - ii. Types of players
     - iii. Level of engagement
   - c. Premise (context)
     - i. Playability of formal system
     - ii. Emotional appeal
   - d. Character
     - i. Empathy
     - ii. Agency
     - iii. Impact
     - iv. Complexity
       1. Round
       2. Flat
   - e. Story
     - i. Uncertainty
     - ii. Progression
       1. Story points
       2. Branching
       3. Emergence
   - f. World building
   - g. Dramatic arc
     - i. Conflict
4. System
   - a. Elements

i. Objects
ii. Properties
iii. Behaviors
iv. Relationships

b. Dynamics
    i. Possibility space
        1. Range
        2. Type
    ii. Economies
        1. Elements
            a. Exchangeable items
            b. Agents of exchange
            c. Methods of exchange
            d. Currency
        2. Type
            a. Bartering
                i. Simple
                ii. Complex
            b. Market
                i. Simple
                ii. Complex
            c. Meta economy
    iii. Emergent

c. Interaction
    i. Information structure
        1. Open
        2. Hidden
        3. Dynamic
    ii. Control
        1. Input
        2. Interface
        3. Range of control
            i. Core mechanics
            ii. Restriction
    iii. Feedback
        1. Reinforcing
        2. Balancing

5. Designing games
    a. Conceptualization
        i. Ideas
            1. Creativity
            2. Analysis

3. Brainstorming
4. Alternate methods
    a. List creation
    b. Idea cards
    c. Mind map

ii. Editing and refining
1. Technical feasibility
2. Market opportunity
3. Artistic considerations
4. Cost restrictions

iii. Ideas to game
1. Prototyping
    a. Formalization
    b. Methods
        i. Physical
            1. Foundation
                a. Fun
            2. Structure
                a. Functional
            3. Formal details
                a. Functional
                b. Internally Complete
                c. Balanced
            4. Refinement
                a. Accessible
        ii. Visualize core gameplay
        iii. Digital
            1. Types
                a. Game mechanics
                b. Aesthetics
                c. Kinesthetics
                d. Technology
            2. Control schemes
            3. Viewpoints
            4. Interface design
                a. Form follows function
                b. Visualization
                c. Grouping features
                d. Consistency

e. Feedback
5. Tools
a. Programming languages
b. Game Engines
c. Level editors

2. Playtesting
a. Goal
i. Player experience
1. Functionality
2. Internally complete
a. Missing elements
b. Loopholes
c. Dead ends
3. Balanced
a. Variables
b. Dynamics
c. Reinforcing relationships
i. Dominant objects
ii. Dominant strategies
d. Symmetrical vs asymmetrical
e. Skill
f. Dynamic balancing
4. Fun
a. Challenge
b. Play
c. Story
d. Player choice
i. Consequences
ii. Dilemmas
e. Rewards and punishments
f. Anticipation
g. Surprise
h. Progress
5. Accessiblility
a. Usability
b. Target audience
b. Process
i. Selection
1. Iterative design

ii. Recruiting
    1. Self-testing
    2. Confidants
    3. Target audience
iii. Conducting
    1. Introduction
    2. Warm-up discussion
    3. Play session
    4. Experience discussion
iv. Methods
    1. Structure
        a. One-on-one
        b. Group testing
        c. Feedback forms
        d. Interview
        e. Open discussion
        f. Data hooks
    2. Play matrix
        a. Skill vs chance
        b. Mental vs Physical
    3. Notes
        a. In-game observations
        b. Postgame questions
        c. Revision ideas
        d. Quantitative data
    4. Test control situations

3. Gameplay vision
    a. Formal elements
    b. Feature design

D1.3. Schell (2008)

i. Game design
    a. Goal
        i. Experience
            1. Psychology
            2. Anthropology
            3. Design

ii. Definitions
    a. Play
        i. Aimless expenditure
        ii. Exuberant energy
        iii. Activities
        iv. State/feeling
        v. Free movement
        vi. Rigid structure
        vii. Spontaneous
        viii. Own sake
        ix. Manipulation
        x. Curiosity
    b. Game
        i. Fun
        ii. Surprise
        iii. Voluntary control systems
        iv. Goals
        v. Contest
        vi. Rules
        vii. Unequal outcome
        viii. Interactive
        ix. Structure
        x. Challenge
        xi. Endogenous meaning
        xii. Closed formal system
        xiii. Engage players
        xiv. Conflict
        xv. Unequal outcome
        xvi. Problem solving
        xvii. Playful attitude

iii. Game elements
    a. Mechanics

i. Procedures
ii. Categories
    1. Functional space
        a. Elements
            i. Discrete vs continuous
            ii. Dimensions
            iii. Bounded areas
        b. Nested spaces
        c. Zero dimensions
    2. Objects
        a. Attributes
            i. States
                1. Information
            ii. Static
            iii. Dynamic
    3. Actions
        a. Operative
        b. Resultant
            i. Emergence
                1. More operative actions
                2. Widely applicable operative actions
                3. Multiple strategies
                4. Many subjects
                5. Side effects
    4. Rules
        a. Types
            i. Foundational
            ii. Operational
                1. Written
                2. Official rules
            iii. Behavioural
                1. Laws
            iv. Advisory
        b. Enforcer
        c. Objective
            i. Concrete
            ii. Achievable
            iii. Rewarding
        d. Modes

5. Skill
    a. Physical
    b. Mental
    c. Social
6. Chance
    a. Probability
    b. Expected value
    c. Human perception

iii. Balance

1. Common types
    a. Fairness
        i. Symmetrical
        ii. Asymmetrical
        iii. Intransitive relation
    b. Challenge vs Success
        i. Flow channel
            1. Increase difficulty on success
            2. Speed through easy parts
            3. Layers of challenge
            4. Choice of difficulty
            5. Playtest variety of players
    c. Meaningful choices
        i. Dominant strategies
        ii. Choices vs Desires
            1. Overwhelming
            2. Frustration
            3. Freedom
        iii. Risk vs reward
    d. Skill vs Chance
    e. Mental vs Physical
    f. Competition vs cooperation
    g. Short vs long
    h. Rewards
        i. Player desires
            1. Praise
            2. Points
            3. Prolonged play
            4. Gateway
            5. Spectacle

6. Expression
7. Power
8. Resources
9. Completion

ii. Reward schemes

1. Reward progression
2. Variable rewards

i. Punishment

i. Fun

1. Create endogenous value
2. Added challenge
3. Excitement

ii. Types

1. Shaming
2. Loss
3. Shortened play
4. Setback
5. Power removal
6. Resource depletion

j. Freedom vs control

k. Simple vs complex

i. Innate complexity

1. Natural vs artifical balancing
2. Elegance
    a. Multi-purpose elements
3. Character

ii. Emergent complexity

l. Detail vs imagination

i. Only detail what you can do well
ii. Detail for understanding
iii. Familiar worlds do not need much detail
iv. Use short binocular effect
v. Details that inspire imagination

2. Methodologies

a. Problem statement
b. Doubling and halving
c. Guess exactly
d. Document model
e. Tune model

f. Plan balancing
3. Game economies
a. Sources
b. Drains

iv. Puzzles
1. Game with objective to find dominante strategy
2. Principles
a. Clear goal
b. Easy to start
c. Sense of progress
d. Sense of solvability
e. Increase difficulty gradually
f. Parallelism
g. Pyramid structure
h. Timed hints
i. Perceptual shifts are doubled edged

b. Story
i. Methods
1. String of pearls
2. Story machine
a. Elements
i. Choices
ii. Conflicts
iii. Personalization
iv. Interest curves
b. Challenges
i. Unity
ii. Combinatorial explosion
iii. Disappointing endings
iv. Not enough verbs
v. Time travel makes tragedy obsolete

ii. Tips
1. Story elements
a. Goals
b. Obstacles
c. Conflict
2. Simplicity and transcendence
3. Structure
a. Hero's journey

4. Playtest
5. Consistency
6. Accessibility
7. Use cliché's judiciously
8. Map can give story life

iii. Integrate story and game
1. Indirect control
a. Feeling of freedom
b. Methods
i. Constraints
ii. Goals
iii. Interface
1. Expected possible actions
iv. Visual design
1. Visual "weenie"
2. Visual guides
v. Characters
1. Empathy
vi. Music
1. Atmosphere
2. Pace
3. Emotion
c. Collusion of character with game designer

c. Aesthetics
i. Value
1. Engagement
2. Pleasure
3. Tolerate imperfections
4. Endogenous value

ii. Guidance
1. Concrete illustrations
a. Concept art
b. Ideas
2. Art style

iii. Audio
iv. Balance art vs technology

d. Technology
i. Foundational
ii. Decorational

iii. Hype cycle
iv. Innovators dilemma
v. Technological progress

iv. Game design setup
a. Theme
i. Unifying theme
ii. Resonance
b. Ideas
i. Inspiration
ii. Problem statement
iii. Idea generation
1. Brainstorming
2. Subconscious
c. Choosing idea
i. Filters
1. Artistic impulse
2. Demographics
3. Experience Design
4. Innovation
5. Business and Marketing
6. Engineering
7. Social/Community
8. Playtesting
ii. Test idea
iii. Iterate
1. Risk assessment
2. Prototype
a. Answers a question
b. Forget quality
c. No attachment
d. Prioritize
e. Parallelize
f. Paper-based
g. Fast-loop engine
h. Build toy first
3. Playtesting
a. Why - playtest to answer a question
b. Who
i. Developers

ii. Friends
iii. Experts
iv. Tissue tester

c. Where
i. Studio
ii. Playtest lab
iii. Public
iv. Target location
v. Online

d. What
i. List of questions
ii. Surprises

e. How
i. To be or not at playtest session
ii. What information to give
iii. Look at faces
iv. Data collection

d. Player
i. Listening
ii. Empathy
iii. Audience
1. Demographics
2. Gender
a. Male
i. Mastery
ii. Competition
iii. Destruction
iv. Spatial Puzzles
v. Trial and Error
vi. Focus on task

b. Female
i. Emotion
ii. Real world
iii. Nurturing
iv. Dialog and verbal puzzles
v. Learn by example
vi. Multi-task

3. Psychographics
a. Game pleasures

i. Sensation
ii. Fantasy
iii. Narrative
iv. Challenge
v. Fellowship
vi. Discovery
vii. Expression
viii. Submission
ix. Anticipation
x. Schadenfreude
xi. Gift giving
xii. Humor
xiii. Possibility
xiv. Accomplishment
xv. Purification
xvi. Surprise
xvii. Thrill
xviii. Triumph
xix. Wonder

b. Player types
i. Achievers
ii. Explorers
iii. Socializers
iv. Killers

iv. Player experience
1. Mental abilties
a. Modelling
i. Reality
ii. Abstraction
b. Focus
i. Selectivity
ii. Flow
1. Clear goals
2. No distractions
3. Feedback
4. Challenge
c. Empathy
d. Imagination
2. Motivation

    a. Maslow needs
        i. Self-actualization
        ii. Self-esteem
        iii. Belonging/Love
        iv. Safety
        v. Physiological
3. Interest curves
    a. Interest progression
        i. Initial interest
        ii. Hook
        iii. Peaks
        iv. Relaxation/Anticipation
        v. Climax
        vi. Resolve
    b. Curve fractions
        i. Overall game
        ii. Levels
        iii. Challenges
    c. Factors
        i. Inherent interest
        ii. Poetry of presentation
        iii. Projection
            1. Empathy
            2. Imagination
            3. Multiple world entry points
4. Worlds
    a. Transmedia worlds
        i. Properties
            1. Powerful
            2. Long lived
            3. Evolve
        ii. Commonalities
            1. Single medium root
            2. Intuitive
            3. Holistic vision
            4. Facilitate stories
            5. Multiple sensible gateways
            6. Wish fulfillment
    b. Game characters

i. Characteristics
    1. More physical than mental
    2. More fantasy than reality
    3. More simple than complex
ii. Avatars
    1. Identity
    2. Ideal form
    3. Iconic
iii. Creation methods
    1. List functions
    2. Define and use traits
    3. Use interpersonal circumplex
    4. Character web
    5. Use status
    6. Voice
    7. Face
    8. Character transformation
    9. Avoid uncanny valley

c. Spaces
    i. Organization
        1. Linear
        2. Grid
        3. Web
        4. Points
        5. Divided
    ii. Components
        1. Landmarks
        2. Liveliness
            a. Nameless quality
        3. No inner contradictions
    iii. Virtual perspective
        1. Scale
            a. People
            b. Doorways
            c. Textures
        2. Viewpoint
            a. Eye-height
            b. Third-person distortion

e. Interface

i. Physical interface
    1. Player input
    2. Physical output
ii. Virtual interface
iii. Feedback
    1. Second-order motion
        a. Juiciness
iv. Communicate information
    1. List and prioritize information
    2. List channels of information
    3. Map information to channels
    4. Review use of dimensions
v. Modes
    1. Use as few modes as possible
    2. Avoid overlapping modes
    3. Distinguish different modes
vi. Tips
    1. Steal
    2. Customize
    3. Theme
    4. Map sounds to touch
    5. Balance options and simplicity with layers
    6. Use metaphors
    7. Test
    8. Help player

D1.4. Bateman & Boon (2006)

1. Audience
    a. Demographic
        i. Clusters
            1. Hardcore vs casual
            2. Genre
            3. EA model
                a. Hardcore
                b. Cool
                c. Mass market
            4. ihobo
                a. Hardcore
                b. Testosterone
                c. Lifestyle
                d. Family
            5. Evangelist
        ii. Market vectors
        iii. Market penetration
            1. Design tools
                a. Gameplay vs toyplay
                b. Control issues
                c. Play session length
                d. Play window
            2. Phases
                a. Hardcore
                b. Hardcore evangelism
                c. Casual
                d. Casual evangelism
    b. Player typology
        i. Myers-Briggs
            1. Personality axes
                a. Extraversion versus Introversion (E vs I)
                b. Sensing versus Intuition (S vs N)
                c. Thinking versus Feeling (T vs F)
                d. Judging versus Perceiving (J vs P)
            2. Sixteen personality types
                a. Gameplay
                    i. Extrovert
                        1. Bored

2. Social
3. Public

ii. Introvert
1. Preference
2. Willing

iii. Sensing
1. Routine material
2. Common sense
3. Familiarity

iv. Intuition
1. Abstract/complex material

v. Thinking
1. Clear goals
2. Likes Critical analysis

vi. Feeling
1. Personal encouragement
2. Feels criticized by analysis

vii. Judging
1. Goal orientation
2. Closed "beat it" structure

viii. Perceiving
1. Process oreitnation
2. Open structure

ix. Challenge vs Fun
1. TJ vs FP

c. Demographic Game Design 1 model
i. Play types
1. Conqueror (TJ)
a. General
i. Enjoy winning
ii. Goal oriented
1. Challenges
2. Strategies
3. Puzzles
iii. Play style
1. Progress
a. Rapid advancement
2. Story
a. Plot/irrelevant

3. Social
    a. Online
b. Hardcore (INTJ, ISTJ)
    i. Completely understand game
    ii. Reach limits
c. Casual
    i. Interpersonal competition
    ii. Schadenfreude

2. Manager (TP)
    a. General
        i. Process oriented
            1. Game mastery
        ii. Open games
            1. Strategy
            2. Management games
        iii. Play style
            1. Progress
                a. Steady
            2. Story
                a. Plot
            3. Social
                a. None
    b. Hardcore (INTP, ISTP)
        i. Use of mastery
        ii. High degree of patience
    c. Casual
        i. Familiarity
        ii. Less patient
        iii. Enjoy construction

3. Wanderer (FP)
    a. General
        i. Fun/unique experience
        ii. Enjoy atmospheric/story-oriented game
        iii. Play style
            1. Progress
                a. New toys
            2. Story
                a. Character/emotion
            3. Social

a. Talk about what they like

b. Hardcore (INFP)
   i. Dreamers
   ii. Finesse
   iii. Less tolerance for challenge
   iv. Gradual progress

c. Casual
   i. Less game-literate
   ii. Relax
   iii. Accomplishing

4. Participant (FJ)
   a. General
      i. Little understood
      ii. Story-oriented
      iii. Social experience
   b. Play style
      i. Progress
         1. Narrative
      ii. Story
         1. Character/emotion
      iii. Social
         1. Multi-player
   c. Hardcore
      i. Story-oriented
      ii. RPG games
      iii. No need for competitiveness
   d. Casual
      i. Group experience

ii. Subtype
   1. Hardcore
      a. Buy and play many games
      b. Longer play sessions
      c. Enjoy challenge, mastery
      d. Tolerate complex controls
      e. Lifestyle preference
   2. Casual
      a. Popular or recommended games
      b. Shorter play sessions
      c. Prefer fun

d. Prefer simpler controls
e. Games as pastime

d. Player abilities
    i. Flow theory
        1. Difficulty
            a. Flow channel
        2. Goals and feedback
            a. Conqueror
                i. Clear goals
                ii. Short term feedback
                iii. Agon
            b. Manager
                i. Long term goals important
                ii. Clear feedback
                iii. Agon (Alea tolerated)
            c. Wanderer
                i. Clear goals
                ii. No patience for being stuck
                iii. Mimicry (Alea tolerated)
            d. Participant
                i. Mimicry
        3. Attainment
            a. Game challenges
                i. Agon
            b. Self-imposed goals
                i. Paidia and mimicry
    ii. Game types
        1. Categories
            a. Agon (competition)
            b. Alea (chance)
            c. Mimicry (simulation)
            d. Ilinkx (vertigo)
        2. Structure
            a. Ludus
                i. Rules
            b. Paidia
                i. Improvisation
    iii. Skill sets
        1. Temperament theory (beahavioral patterns)

a. Rational (NT)
    i. Strategic
b. Idealist (NF)
    i. Diplomatic
c. Artisan (SP)
    i. Tactical
d. Guardian (SJ)
    i. Logistical

iv. Flow and DGD1 model
1. Conqueror
    a. Strategic-Logistical
2. Manager
    a. Strategic-Tactical
3. Wanderer
    a. Diplomatic-Tactical
4. Participant
    a. Diplomatic-Logistical

2. Game design
a. Philosophy
i. Zen game design
1. No single method
a. More methods more options
b. Varieties
i. First principles
1. Game world abstraction
2. Design
ii. Clone and tweak
iii. Meta rules
iv. Technology driven
v. Material-driven
vi. Story-driven
vii. Iterative Design
2. Design reflects needs
a. Target audience
b. Publisher
c. Developer
d. Programmers
e. Artists
f. Marketing

            g. License holder
    b. Foundation
        i. Phases
            1. Concept
                a. Developer-Publisher relation
                b. Ideas
                c. Concept document
                    i. User Interface
                    ii. Core mechanics
                    iii. Game structure
                    iv. Narrative
            2. Initial design
3. Interface design
    a. Basics
        i. Components
            1. Front-end
            2. In-game menus
            3. Control Mechanism
        ii. Principles
            1. Simplicity
            2. Expressibility
            3. Learning curve
        iii. Golden rules
            1. Be consistent
            2. Simplest feasible
            3. Draw from familiar
            4. One button one function
            5. Structure learning curve
        iv. Cautions
            1. Shortcuts for advanced users only
            2. Icons for speed, text for clarity
            3. Allow skipping non-interactive sequences
            4. Provide options and save options
            5. Document
    b. Action space
        i. General
            1. Small action space
            2. Sufficient expressibility
        ii. Measure of complexity

1. Controle scheme
    a. Dimensionality of control
        i. Degrees of freedom of movement
        ii. Different ways of moving
        iii. Enfolded control
        iv. Non-spatial atomic actions
2. Menu
    a. Action depth

c. Immersive menus
    i. Embedded functionality
    ii. Different game modes
d. Tutorials
    i. Control flashcards
    ii. Training movie
    iii. Linear exercises
    iv. Goal-oriented
    v. Help signs
    vi. Imbedded manual
    vii. Context-sensitive commentary
    viii. Checklist
    ix. Staggered complexity

4. Game world abstraction
    a. Components
        i. Rules
        ii. Nature of game world
        iii. Potential interactions
        iv. World representation
    b. Motivations for abstraction
        i. Technical limitations
        ii. Budget limitatins
        iii. Goals
            1. Meet audience needs
            2. Scope of vision
    c. Abstractions
        i. Logic and reality
            1. Realism
                a. Choice of components
                b. Perception
            2. Use player expectations

3. Internally consistent
4. Teaching game logic
    a. Specific challenges
    b. Repitition

ii. Perspective
1. First person
    a. Immersion
    b. Limited field of vision
    c. High dimensionality of control
    d. Navigation tool
2. Third person
    a. Versatile
    b. More animation
    c. Simpler controls
    d. Camera
        i. Control
        ii. Fixed vs dynamic
        iii. Distant observer

iii. Avatars
1. Relationship world avatar and player
    a. Behind the scenes action
    b. Character
        i. Playing in character
        ii. Character expression
2. Mortality
    a. Lives
    b. Health
    c. Invulnerability
    d. Time
3. World interaction
    a. Hotspots
    b. Cosmetic
4. Abilities
    a. Resources
    b. Power ups
    c. Permanent increases
    d. Inventories
5. Opposition
    a. Fighting

            b. Avoiding
            c. Bosses
        iv. World division
            1. Levels
                a. Discrete
                b. Continuous
            2. Domains
                a. Connected in larger structure
                b. Mini-worlds
            3. Maps
        v. Time
            1. Resetting vs dynamic environments
            2. Persistent world
            3. Rewinding
            4. Passage of time
5. Game structures
    a. Gameplay related
        i. Player activities
            1. Pathfinding
                a. Optimize game progression
                b. Forward pushing
                c. Discrete vs continuous levels
            2. Housekeeping
                a. Explorative
                b. Familiarity
                c. Collecting
                d. Domains and contiguous worlds
        ii. Progress mechanisms
            1. Barriers
            2. Tokens
            3. Currency
            4. Key itemsSymbolic keys
                a. Functional keys
                b. Tool keys
    b. Toyplay
        i. Playground worlds
    c. Techniques
        i. Breadcrumbing
        ii. Funneling

iii. Replay features

d. Save game functionality

D1.5. Salen & Zimmerman (2004)

1. Game design
    a. Patterns of complexity
    b. Theoretical aspects
    c. Practical aspects
    d. Fundamentals
        i. Design
        ii. Systems
        iii. Interactiviy
        iv. Player
            1. Choice
            2. Action
        v. Outcome
        vi. Rules
            1. Making
            2. Breaking
            3. Relation with play
        vii. Complexity
        viii. Emergence
        ix. Game experience
        x. Game representation
        xi. Social game interaction
        xii. Pleasures
        xiii. Meanings
        xiv. Ideologies
        xv. Stories
2. Common vocabulary
    a. Training
    b. Generational transfer
    c. Audience-building
    d. Buffer against criticism
3. Game design schemas
    a. Rules
        i. Logical structures
        ii. Mathematical structures
    b. Play
        i. Experiential
        ii. Social
        iii. Representational

- c. Culture
  - i. Contextual

4. Design process
   - a. Iterative design
     - i. Prototyping
     - ii. Playtesting
5. Core concepts
   - a. Meaningful play
     - i. Descriptive
       1. Player action
       2. System outcome
     - ii. Evaluative
       1. Discernable
          - a. Feedback
       2. Integrated
          - a. Throughout game trajectory
   - b. Design
     - i. Context
     - ii. Participant
     - iii. Meaning
   - c. Systems
     - i. Elements
       1. Objects
       2. Attributes
       3. Internal relationships
       4. Environment
     - ii. Framing
       1. Formal
       2. Experiential
       3. Cultural
     - iii. Types
       1. Open
          - a. Exchange with environment
       2. Closed
          - a. Isolated from environment
   - d. Interactivity
     - i. Modes
       1. Cognitive
       2. Functional

3. Explicit
4. Beyond-the-object

ii. Designed interaction
1. Specific context
2. Outcome

iii. Choices
1. Micro
2. Macro
3. Basic unit
a. Action > outcome
b. Stages
i. Before choice
ii. Conveying possibility choice
iii. Making choice
iv. Result of choice
v. Conveying of result
4. Space of possibility

e. Defining games
i. System
ii. Players
iii. Artificial
iv. Conflict
v. Rules
vi. Quantifiable outcome

f. Defining digital games
i. Immediate but narrow interactivity
ii. Manipulation of information
iii. Automated complex systems
iv. Networked communication

g. Magic circle
i. Game boundaries
1. Formal
2. Informal

ii. Game space
1. Entering
2. Open
3. Closed

6. Primary schemas (lenses)
a. Rules

i. Definition
    1. Formal structure
    2. Limit player action
    3. Explicit and unambiguous
    4. Shared by all players
    5. Fixed
    6. Binding
    7. Repeatable
ii. Types
    1. Operational
        a. Direction for play
    2. Constituative
        a. Abstract game logic
    3. Implicit
        a. Etiquette and behavior
iii. Game identity
    1. Interplay operational and constitutional rules
    2. Specificity of rules
iv. Elegant design
    1. Allow players to focus on experience
    2. Meaningful play
        a. Action > outcome
            i. Discernable
            ii. Integrated
        b. Complexity
        c. Uncertainty
        d. Balance of freedom of action
        e. Feeling of control
v. Embedded design schemas
    1. Games as emergent systems
        a. Complexity
            i. Categories
                1. Fixed systems
                2. Periodic systems
                3. Complex systems
                    a. Complex interrelated systems
                    b. Simple complexity
                4. Chaotic systems
        b. Emergence

        i. Emergent systems
            1. Whole greater than sum of parts
            2. Unpredictable complexity from limited set of rules
            3. Bottom-up behavior
        ii. Object interactions
            1. Coupled
            2. Context-dependent
        iii. Emergence in games
            1. Player behavior
            2. Large possibility space
            3. Second-order design problem
2. Games as systems of uncertainty
    a. Decision-outcome relations
        i. Uncertainty
        ii. Risk
        iii. Certainty
    b. Feeling of randomness
    c. Probability
        i. Player behavior
            1. Chance fallacies
            2. Strategic use of chance
3. Games as information theory systems
    a. Information theory
        i. Meaning is irrelevant to information
        ii. Information measures uncertainty
            1. Measure of freedom in decision making
    b. Communication
        i. Noise
        ii. Redundancy
    c. Design balancing in games
        i. Information
        ii. Signals
        iii. Noise
        iv. Redundancy
4. Games as systems of information
    a. Information as knowledge
        i. Perfect information
            1. Analytical
            2. Competitive

ii. Imperfect information
1. Mystery
2. Uncertainty
iii. Scenarios
1. Known to all players
2. Known to one player
3. Known to game
4. Randomly generated

b. Economy of information
i. Objective
ii. Perceived

c. Information in games
i. Hiding and revealing systems
1. Fog of war
2. Secret locations and hidden moves
3. Item economies
4. Rules as information

5. Games as cybernetic systems
a. Elements
i. Sensor
ii. Comparator
iii. Activator

b. Feedback systems
i. Positive feedback
ii. Negative feedback

c. Feedback in games
i. Elements
1. Game state
2. Sensor
a. Scoring function
3. Comparator
a. Controller
4. Activator
a. Game mechanical bias

ii. Dynamic difficulty adjustment
iii. Positive feedback
1. Destabilize

iv. Negative feedback
1. Stabilize

6. Games as game theory systems
    a. Theory of decision making
        i. Decision trees
        ii. Strategies
    b. Game theory game
        i. Limits
            1. Rational player
            2. Simultaneous
            3. Strategy
            4. Outcome
            5. Utility
        ii. Payoff matrix
        iii. Degenerate strategies
        iv. Mixed strategies
7. Games as systems of conflict
    a. Conflict
        i. Intrinsic of games
        ii. Emerges from goals
    b. Game conflict
        i. Competitive
        ii. Cooperative
        iii. Victory and loss conditions
        iv. Fairness
8. Rule-breaking
    a. Player types
        i. Standard player
        ii. Dedicated player
        iii. Unsportsmanlike player
        iv. Cheat
        v. Spoil-sport
    b. Comparison
        i. Degree of lusory attitude
        ii. Relationship to rules
        iii. Interest in winning

b. Play
    i. Definition
        1. Experience
            a. Types
                i. Input

1. Visual scanning
2. Auditory discriminations

ii. Output
1. Motor responses

iii. Internal process
1. Concentration
2. Perceptual patterns of learning

b. Core mechanic
i. Repeated activity
ii. Extended by variations

2. Behavior
a. Game play
b. Ludic activities
c. Playfulness

3. Free movement in rigid structure
4. Transformative play
a. Agon
b. Alea
c. Mimicry
d. Ilinx

ii. Embedded schemas
1. Games as play of pleasure
a. Pleasure in games
i. Autotelic
ii. Seduction
1. Enter magic circle
2. Remain in circle

iii. Same but different
iv. Goal achievement
1. Short-term goals

b. Flow
i. Challenge
ii. Anxiety

c. Behavior theory
i. Conditioning
1. Reinforcement schedules

2. Games as play of meaning
a. Systems of representation
i. Games represent

        ii. Games are representations
    b. Meaning
        i. System
        ii. Context
        iii. Space of representational possibility of a game
        iv. Magic circle
    c. Cognitive frame
    d. Metacommunication
3. Games as narrative play
    a. Shaping narrative
        i. Goals
        ii. Conflict
        iii. Uncertainty
        iv. Core mechanic
        v. Game space
    b. Game representation
        i. Narrative descriptor
            1. Constraint for design space of possibility
            2. Fictive worlds
            3. Story events
        ii. Narrative system
            1. Cutscenes
            2. Retelling play
4. Games as play of simulation
    a. Game representation
        i. Procedural representation of reality
        ii. Types of conflict
            1. Territorial
            2. Economic
            3. Knowledge
    b. Simulations
        i. Characteristics
            1. Abstract
            2. Numerical
            3. Limited
            4. Systemic
        ii. Structure
            1. Case-based
            2. Generalized

c. Metacommunication
d. Remediation
    i. Immediacy
        1. Authentic representation
    ii. Hypermediacy
        1. Constructed nature
e. Player consciousness
    i. Identification with character
    ii. Engagement with procedures as player
    iii. Existence in context as person

5. Games as social play
    a. Play interactions
        i. Internally
            1. Functioning game rules
        ii. Externally
            1. Outside magic circle
    b. Community
        i. Bounded play
            1. Within space of individual game
            2. Social contract
                a. Safety
                b. Trust
        ii. Open play
            1. Exchange between game and environment
    c. Players
        i. Role
        ii. Player categories
            1. Achievers
            2. Explorers
            3. Socializers
            4. Killers
        iii. Rules
            1. Official
            2. Community held
            3. Own variants
    d. Transformative social play
    e. Forbidden play
    f. Metagaming

c. Culture

i. Definition
    1. Outside magic circle
    2. Games
        a. Reflect culture
        b. Can transform culture
    3. Game representation
        a. Cultural representation
ii. Embedded schemas
    1. Games as cultural rhetoric
        a. Rhetorics of play
            i. Progress
            ii. Fate
            iii. Power
            iv. Identity
            v. the Imaginary
            vi. Rhetoric of the self
            vii. Frivolity
        b. Rhetoric of gender
    2. Games as open culture
        a. Premises
            i. Play occurs on cultural level
            ii. Games exchange meaning with environment
        b. Player as producer
            i. Metagaming
            ii. Emergence in games
            iii. Open source development
    3. Games as cultural resistance
        a. Tension between games and cultural context
            i. Friction
        b. DIY modifications Alteration
            i. Juxtaposition
            ii. Reinvention
    4. Games as cultural environment
        a. Blurred distinction inside and outside magic circle
        b. Link games to real world
            i. Implicit rules
                1. Etiquette

2. Ethos
3. Convention
4. Context

D1.6. Rollings & Morris (2007)

1. First concept
    a. Skills
        i. Creativity
        ii. Craft
        iii. Technique
    b. Stages
        i. Idea generation
        ii. Written treatment
        iii. Taking stock
            1. Analysis
            2. Evaluation
                a. Fun
                b. Unique selling points
            3. Justification
    c. Creative process
        i. Inspiration
            1. Originality
            2. Everywhere
        ii. Synthesis
            1. Pick & Mix
        iii. Resonance
            1. Synergy
            2. Theme
        iv. Convergence
            1. Critical judgment
    d. Idea shaping
        i. Dramatic effect
            1. Style
                a. Genre
                b. Execution
            2. Plot
            3. Character
            4. Setting
            5. Theme
2. Core design
    a. Gameplay
        i. Meaningful choice
            1. Upside

2. Downside
3. Factor dependent

ii. Strategy

1. Strategic choice
    a. Medium-term
    b. Long-term
2. Dominant strategy
    a. Near-dominance
    b. Transitive relation

iii. Interesting choice

1. Supporting investments
    a. Secondary objectives
    b. Shadow costs
2. Versatility
3. Compensating factors
4. Impermanence
5. Synergies

iv. Interaction of choices

b. Interactivity

i. Types

1. Affecting game world
2. Direct control
3. Indirect control
4. Choosing point of observation
5. Selecting elements of interest

ii. Why over what happens

c. Objectives

3. Detailed design

a. Development timeline

i. Development phase
ii. Duration
iii. Process
iv. People
v. Outcome

b. Design documentation

i. Gameplay spec

1. Overview
2. Look and Feel
3. Players

4. Objectives
5. Features
    a. Emergent
    b. Value adding
        i. Integral
        ii. Chrome
    c. No value
        i. Gameplay substitutes
6. Gameplay
    a. Workings
    b. Vision
    c. Distinguish features
7. Interface
    a. Help player
    b. Control
8. Rules
    a. Serve features
9. Level design
    a. Complement core design
    b. Represent gameplay
    c. Non-linearity

ii. Designer notes
1. Document all ideas
    a. Contingency
    b. Reasoning behind decisions

c. Fitting design to development
i. Iterative spiral process
1. Tiers
    a. Goals
    b. Philosophy
    c. Expected results
    d. Alternatives
2. Testbeds

4. Game balance
a. Player/Player
i. Skill vs random elements
ii. Symmetry
1. Level design
    a. Functional

            b. Aesthetic
        2. Game design
    b. Player/Gameplay
        i. Interactivity
        ii. Challenge vs skill
            1. Reward player
                a. Gameplay
                b. Aesthetic
                c. Better experience
            2. Let machine work
                a. Chore vs feature
            3. Play with game not against
    c. Gameplay/Gameplay
        i. Component balance
            1. Embodied by artifacts
        ii. Attribute balance
            1. How artifacts are used
        iii. Interaction of choices
        iv. Combination of choices
        v. Intransitive game mechanics
            1. Three-way-relation
            2. Design scalability
                a. More than three options
                b. Combinatorial explosion
5. Look and feel / Immersion
    a. Ambience
        i. Innate look and feel
        ii. Unfolding story
            1. Sound
            2. Vision
            3. Touch
                a. Handling of game
    b. Interface
        i. Ideally transparent
            1. Minimize intrusion
        ii. Intuitive controls
            1. Pointer position
            2. Actions done so far
    c. Storytelling

i. Toolbox
    1. Obstacles
    2. Foreshadowing
    3. Personalization
    4. Resonance
    5. Resistance
    6. Plot points
        a. Reversal
        b. Discovery
        c. Calamity
    7. Suspense
    8. Dialogue
    9. Theme
    10. Resolution
        a. Hard won
        b. Not obvious, but sensemaking
        c. Satisfying
        d. Consistent
        e. Closure
    11. Change

6. Essentials
    a. Original
    b. Coherent
    c. Interactive
    d. Interesting
    e. Fun

D1.7. Schuytema (2007)

1. Game
    a. Definition
        i. Activity
        ii. Actions and decisions
        iii. Rules
        iv. Game world
        v. End condition
        vi. Electronic media
        vii. Context
        viii. Challenges
        ix. Journey
    b. Atoms
        i. Clear goal
            1. Goal presentation
            2. Reminder
        ii. Nested victories
            1. Sense of accomplishment
            2. Smaller challenges
        iii. Player as agent of change
        iv. Understandable context
        v. Understandable rules
        vi. Skill is required
        vii. Feedback
        viii. Consisten interface
        ix. Challenge
            1. AI
            2. Complex patterns
            3. Close victories
            4. Varying challenges
            5. Cost of failure
        x. Breaks
        xi. Randomness
            1. Reduce predictability
            2. Avoid extremes
        xii. Navigation
        xiii. Abilities
            1. Prepare for greater challenge
        xiv. Story

1. Serves gameplay

2. Concept of fun
    a. Receptiveness
    b. Expectations
    c. Subjective likes
    d. Ingredient X
        i. Surprise
        ii. Conincidence
        iii. Flash of genius
        iv. Extreme emotion
        v. Transietness
        vi. Shattered expectation
3. Game design
    a. Process
        i. Core concept
            1. High concept
                a. Essence of game
                b. Set in stone
            2. Main principles
            3. Major features
        ii. Design documents
            1. Pitch
                a. Proof-of-concept
                b. Audience
                c. Platforms
                d. Differentiation from competitors
            2. Scope
                a. Platforms
                b. Players
                c. Genre
                d. High concept
                e. Goal
                f. Features
            3. Game design
                a. Core overview
                    i. Summary
                    ii. Key asepects
                    iii. Golden nuggets
                        1. Differentiating aspects

    b. Game context
        i. Game story
        ii. Backstory
        iii. Primary players
            1. Main characters
    c. Core game objects
        i. Characters
        ii. Weapons
        iii. Abilities
        iv. Structures
        v. Objects
    d. Conflict and resolution
        i. Interactions between game entities
    e. Artificial Intelligence
    f. Game Flow
        i. Placement of game objects within game environment
    g. Controls
        i. User inputs
    h. Game Types
    i. Definitions
    j. References
4. Game Data
5. Technical design
    a. Primary new development areas
    b. Internal tools
    c. Hardware or software to acquire
6. Functional specification
    a. Player perspective
7. Tools design
    a. Game-specific tools
8. Asset list
    a. Contents to be created
9. Marketing plan
    a. Advertising
    b. Requirements
10. Localization plan
11. Target list
    a. Essential features
    b. Key features

            c. Non-vital features
    b. Development cycles
        i. Pre-production
            1. Concept
            2. Brainstorming
            3. Evaluation of competitors
            4. Getting resources
            5. Design documents
        ii. Production
            1. Artists
                a. Character models
                b. Levels
            2. Programmers
            3. Marketing
            4. Designers
                a. Gameplay scripting
                b. Evalaute fun
                c. Functionally consistent
                d. Refinement
        iii. Post production
            1. Additional content
            2. Balancing
4. Game designer
    a. Design phase
        i. Writing
        ii. Listening
        iii. Cheerleading
        iv. Stewardship of ideas
        v. Idea generation
        vi. Visualization
        vii. Prototyping
        viii. Scripting
    b. Project phase
        i. Living design
        ii. Content
        iii. Levels
        iv. Game testing
5. Player experience
    a. Perception

i. Sound
    1. Effects
        a. Aural texture
        b. Information
        c. Feedback
    2. Music
        a. Background
        b. Emotion
ii. Movement
    1. Game world window
    2. Interface
iii. Light and color

iv. Patterns
    1. Automatic operation
    2. Discovery
v. Immersive perception
    1. Imagination
    2. Player understanding of game world
    3. Difference real world
        a. Granularity

b. Emotions
    i. Flow
        1. Lost in the moment
        2. Immersed
    ii. Achievement
    iii. Problem solving
    iv. Socializing
    v. Emotional reactions
        1. Character
        2. Story
    vi. Unexpected moments
    vii. Addictive behavior
        1. Sense of progress
        2. Not full achievement

c. Challenge
    i. Actions
        1. Clear goal
        2. Engagement

ii. Game flow
    1. Peaks
    2. Valleys
    3. Progression
iii. Types
    1. Escalating and varied
        a. Core player skills
    2. Risk and reweard
    3. Adaptive
    4. Boss encounters
        a. Fit game world context
        b. Longer than normal
        c. Dominate player attention
        d. Constant player inpout
        e. Risk and danger
        f. Opportunity for recovery
        g. Complex, pattern-based behavior
        h. Multiple targets
        i. Victory provides rest
        j. Replay path is short
        k. Be wary of player frustration
    5. Other people
    6. Multiple variables
iv. Structure
    1. Linear
    2. Non-linear

d. User Interface
    i. Interface atoms
        1. Act as expeccted
        2. Consistent
        3. Do not require player to remember
        4. Inform game world state
        5. Layers of information
        6. Alert vital changes
        7. Protect from errors
        8. Reflect tone of game
        9. Not overpowering
        10. Feedback
    ii. General design

1. Front-end
    a. Information required from player
    b. Options
    c. Key actions
    d. First impression
2. Informational display Essential information to display

    a. Important information
    b. Layout

e. Environment design
    i. Key roles
        1. Container for interactivity
        2. Tone and feel
        3. Guide and direct play
    ii. Design
        1. Concept art
        2. Sketch world
        3. Continuity
        4. Style guide
        5. Mood
        6. Façade of freedom
        7. Resource struggling
    iii. Level design
        1. Theme
        2. Purposeful architecture
        3. Know technology
        4. Embrace novel ideas
        5. Avoid red herrings
        6. Take advantage of revisiting
        7. Avoid repetitious patterns
        8. Multiplayer or single-player
f. Conflict design
    i. Static obstacles
        1. Fit into game world
        2. Vary obstacle
        3. Train the skills
        4. Anticipate if player can "go around" obstacle
    ii. Dynamic obstacles

1. AI is a façade
2. Minimize AI cheating
3. Simple parameters
4. Some randomness is good
5. Give AI goals

g. Game flow design
   i. Missions and scenarios
      1. Single key to mission
      2. Keep goal simple
      3. Inform victory conditions
      4. Introduce tactics
      5. Alert to changing goals
      6. Ramp up difficulty
      7. Create story arc
      8. Use "forced defeat" sparingly
      9. Equal balanace equals boring
      10. Replayability
   ii. Campaigns
      1. Static or dynamic
      2. Research
      3. Nested victories
      4. Meta story arc
      5. Strategic decisions

h. Storytelling
   i. Identify hero
   ii. Define problem
   iii. Strive to overcome problem
   iv. Last chance
   v. Allow climax to sink
   vi. Understand plot arc
   vii. Outline
   viii. Write
   ix. Revise
   x. Have a theme
   xi. Narrow focus

D2. Second phase of coding process – high level concepts

Table 31 Overview of level 1 and level 2 concepts of the analyzed entertainment game design literature sources.

Adams & Rollings (2007)		Fullerton (2008)		Schell (2008)		Bateman & Boon (2006)		Salen & Zimmerman (2004)		Rollings & Morris (2007)		Schuytema (2007)	
Level 1	Level 2	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2	Level 1	Level 2
Game elements	Play	Playcentric design	Player experience	Game design	Goal	Audience	Demographic	Game design	Patterns of complexity	First concept	Skills	Game	Definition
	Pretending		Prototyping	Definitions	Play		Player typology		Theoretical aspects		Stages		Atoms
	Goal		Playtesting		Game		Demographic Game Design 1 model		Practical aspects		Creative process	Concept of fun	Receptiveness
	Rules		Iteration	Game elements	Mechanics		Player abilities		Fundamentals		Idea shaping		Expectations
Entertain	Gameplay	Formal elements	Players		Story	Game design	Philosophy	Common vocabulary	Training	Core design	Gameplay		Subjective likes
	Aesthetics		Objectives		Aesthetics		Foundation		Generational transfer		Interactivity		Ingredient X

	Harmony		Procedures		Technology	Interface design	Basics		Audience-building		Objectives	Game design	Process
	Storytelling		Rules	Game design setup	Theme		Action space		Buffer against criticism	Detailed design	Development timeline		Development cycles
	Risks and Rewards		Resources		Ideas		Immersive menus	Game design schemas	Rules		Design documentation	Game designer	Design phase
	Novelty		Conflict		Choosing idea		Tutorials		Play		Fitting design to development		Project phase
	Learning		Boundaries		Player	Game world abstraction	Components		Culture	Game balance	Player/Player	Player experience	Perception
	Creative and expressive play		Outcome		Interface		Motivations for abstraction	Design process	Iterative design		Player/Gameplay		Emotions
	Immersion	Engagement/Dramatic elements	Challenge				Abstractions	Core concepts	Meaningful play		Gameplay/Gameplay		Challenge
	Socializing		Play			Game structures	Gameplay related		Design	Look and feel / Immersion	Ambience		User Interface

Design components and processes	Player-centric design		Premise (context)				Toyplay		Systems		Interface		Environment design
	Core mechanics		Character				Techniques		Interactivity		Storytelling		Conflict design
	User interface		Story				Save game functionality		Defining games	Essentials	Original		Game flow design
	Structure		World building						Defining digital games		Coherent		Storytelling
	Design stages		Dramatic arc						Magic circle		Interactive		
	Balancing	System	Elements					Primary schemas (lenses)	Rules		Interesting		
			Dynamics						Play		Fun		
			Interaction						Culture				
		Designing games	Conceptualization										