Expanding the Game Design Space

- Development of computer games in higher education.

This abstract is regards game design research in educational settings. It focuses on computer game design in higher education especially education of engineers. The notion of game design space encapsulates the entire development process from beginning to end with emphasis on game design thinking in the development of computer games. Through the last fire years we have been teaching game design courses at the university. Our goal have been twofold: 1) we wanted to create an easily understandable game design model to communicate something as complex as game design and 2) make sure our students learned to act, think, and feel like game designers. In order to meet such an ambition we have over the years discovered a need for clear framing. The first year our framing of the game design process, the outcome, and game design thinking was deficient. Over the years our framing of the design space were expanded, it became better defined and multifaceted. The results in the classroom quickly materialised both in relation to development of greater games and to divergent and creative thinking in the design space.

The expanded game design space consists of four separate yet interconnected layers in the process of game development. The first layer addresses the importance of framing with a clear game design assignment, formulation of intended player experience and description of game mechanics. The second layer creates game design thinking from six different parameters of game design elected in regard to framing of the game design assignment. The third layer sees a clear correspondence between formal elements of computer games and the structure of problem-based creativity. It addresses how game design challenges can be stated and how creative solutions can be measured. The fourth and final layer demonstrates how clear framing can act as guideline for evaluating game design thinking and for measuring solutions made in development process. To strengthen our notion of expanded design space we will present examples from our game design courses.

Keywords: game design, computer games, design space, learning, higher education.

INTROCTION

This abstract presents research done in our computer game design courses the higher education. During the first years of our courses we didn't get the desired results both in regard to the quality of student games or their level of game design thinking. We evaluated the courses and realised we needed a clearer framing of the game design assignment. This to ensure students didn't lose their footing in a field as huge as game design. We also wanted our students to learn to think like game designers.

This posed problem: how could we frame the entire computer game design process in an easy and understandable way and at the same time get students to learn how to think, act, value and feel like computer game designers (Gee, 2003). After considerably research we developed the notion of an expanded game design space, which we have discovered, lead to development of better games, enhance game design thinking, and instil critical learning about game design in our students.

Our understanding of learning game design rests on or is in line with the concept of epistemic frames (Shaffer, 2006). Learning to think, act and value like game designers demand a mind frame that entails a certain attitude in relation to game design. Our notion of expanded design space greatly facilitates that ambition.

LEARNING PHILOSOPHY

Our learning philosophy is based on active participation and reflection (Bateson, 2000; Schön, 1983; Majgaard, 2013). The students participate actively in the design process and develop prototypes in collaboration with user groups (Sharp, 2007). We promote a particular way of thinking in the design process in order to optimise and improve student design practice.

During our game design courses we observed what we later coined problem-based creativity. This creativity stems from understanding design challenges much like games. Looking a design challenges as mini-games consisting of a clear goal (solution), challenge (what is the design problem), conflict (how do we solve the design problem without) and variable outcome (solutions can be many small or far reaching) creates particular way of game design thinking. It should be noted that our understanding of creativity is inspired by Scharmer (2000) and Gee (2003) who both work with emerging learning or as Scharmer describes it as "not-yet-embodied knowledge" thereby emphasizing the not yet realised as opposed to the reproduced (Engeström 1986).

Our notion of game design space rest upon empirical research from our computer game design courses at the university. The research method is inspired by design-based research and action research (Majgaard at al., 2011) and contains iterative cycles of observation, dialogue in classroom settings and reflections. Our goal has been to develop and explore game design in the classroom setting. Our students are first semester engineering students and student productions can be viewed on the webpage www.op.tek.sdu.dk.

Our research contribution entails a notion of the game design space through which students learn to think, act, value and feel in a particular way – namely as game designers.

DIDATICAL APPROACH

Our game design course is, as already stated, organised through framing. The students get a very clear game design assignment, which is to develop an asymmetrical multiplayer hotseat competitive computer game. The assignment should be understood as a framework consisting of particular parts each of which have been thoroughly selected and reflected upon.

The first part of shaping the game asymmetrically expands from a desire to open possibilities of game testing with focus on *game balancing*. Thereby making game tests a priority in the game design process beyond mere bug and collision finding exercises. When combining game balancing and *game testing* they become an important a part of game design thinking and understanding the development process. Using game test as a way to reflect upon the current state of their games students learn to closely analyse the *relationship of formal game elements*. They learn to add or subtract game elements in relation to *structuring player strategies and choices*. The *multiplayer* part is chosen because it eliminates using AIs and thereby navigating the students away from spending precious time programming complex AIs (not that we in any way disregard using AIs in games). The underlying rationale is that the opposing player constitutes the best possible AI. The *hotseat* dimension where two or more players share the same keyboard during game play removes difficult network programming from the game design equation. Instead we underscore focus on game design and not on technical programming issues. It should be noted that we understand the concept of multiplayer hotseat outside its original definition. Instead of designing turn-based games we inspire students to design real-time competitive games. If the students have a desire to make turn based or co-operative games they can do that. Currently we are thinking about adding a particular perspective to the assignment in order to filter out side-scrollers since they inherently pose difficulties in regard to properly using the upper half of the screen thereby reducing the game space complexities.

The game design course runs over 12 weeks consisting of 8 weekly hours divided into two sessions of 4 hours each. Students are assigned to design a working game and write a final report (games can be found here http://op.tek.sdu.dk/?cat=70). During the 4-hour sessions we review and discuss different aspects of game design in relation to the assignment of the game design course along with relevant exercises. In the first 6 sessions groups of 4 students are formed and they get to know each other while they develop a minimum of 3 different ideas which they prototype on paper. Presentation and feedback on the prototypes is designed as a rolling playtest session where every group get to see and try out the other group's game design ideas. Paper prototypes make it easier to filter out game ideas with the best design potentials. They choose the idea they wish to pursue. To control the development process students create a design document consisting mostly of a bag log description of the formal game elements including need and nice to have aspects. They are told to divide the workload between them organised in scrum like routines where different group members perform certain actions to specific dates. Outside the university they meet up one time each week. Over the entire course we hold as many game test sessions and presentations we can with a minimum of 3 presentations (including 3 small papers on selected game design topics) in class and 5 or more game test sessions since student always in the beginning understand those sessions as bug finding tools and discussions about collision and other programming issues since they don't feel like they have anything to show the other groups. Later on when they begin to see game tests as part of the game design development process they value input since they reflect how other players and fellow designers view games. Such views often point out overlooked and un-thought of game design issues. They finish the course with and oral examination where they reflect upon selected aspects of game design theory and discuss the development process in relation to their report.

THE GAME DESIGN SPACE

The first part of our notion of game design space addresses precise and thought through *framing* of the game design assignment. Clear framing makes it easier to get a handle of a dazzling new and highly complex topic, game design. Apart from framing the entire process with a clear assignment students need to get a clear idea of what kind of player experience they wish to design. This aspect is player centric and circles *player experience* as a crucial aspect of game design (Fullerton 2008, Schell 2008). But as everybody in the field of game design knows player experiences can be or mean many different things. It could be argued that players always experience something when they play a game. If that is the case what exactly does it mean to design player experience?

Our course experience and research shows that successful game design rests on articulation of a very precise description of the experience designers wish to communicate to players. The litmus test to this problem can be addresses like this: give a short answer to the question *what kind of player experience do you wish to communicate with your game*. If game designers can answer that they are close at establishing a clear game design point of departure.

Clear formulations of what kind of player experience designers wish to communicate constitute the *second* part of framing the development process. We remember that the first part entails the game design assignment, while the second part is concerned with establishing intended player experience "inside" the overall game design assignment. The *third* part of the crating the design space evolves around game mechanics (Sicart, 2008). Sicart explains game mechanics as "methods invoked by agents for interacting with the game world". Later on, Sicart expands and clarifies the initial definition by correlating it with "verbs" in sentences. Thereby describing game mechanics as *actions* players (agents/non player characters) can

take in game worlds. In first person shooters (FPS) players can shoot, jump, crouch and reload and in massive multiplayer games (MMOGs) players can (among a lot of things) teleport, become invisible or dissolve they avatar only to become complete again as in Skylanders or as in League of Legends (LoL) where each champion can invoke a particular set of actions or methods when combatting opponents. All these actions constitute methods players can invoke when interacting in a game world. They are what we understand as game mechanics.

When our game design students have articulated exactly what kind of player experience they wish to communicate *and* designed game mechanics accordingly they have a very strong point of game design departure as well as a powerful guideline to support the rest of the game design development process. The last part is important since it promotes a measurement for navigating the complexities embedded in the entire game design process.

A strong correlation between a clear game design assignment, a clear formulation of intended player experience and associated game mechanics establishes the foundation for our notion of game design space.

The design space can be described as a virtual sandbox. A place where students can be playful, creative, innovative and where is ok to make mistakes without fear for rejection (Gee, 2003; Majgaard, 2013). Bateson (2000) also describes a playful space as an opportunity to explore possibilities and outcomes without real-world consequences.

GAME DESIGN THINKING

Game design thinking is in *general* structured by the design space. The *particular* game design thinking can be explained as a matrix based on the most influential dimensions derived from the game design space.

This matrix rests on six different yet closely interrelated aspects of game design. The *first* aspect consists of formal game elements (Fullerton, 2008, Salen & Zimmerman, 2004). This has to do with listing as many formal elements of the game as possible especially listing and understanding objects, their properties, behaviour and relationships. And perhaps most importantly understand how unpredictable it is to see static formal game elements act when put into motion. At this point game testing even more critical. Design thinking in the design space is thereby deeply correlated with game testing especially performed with how objects and their properties and behaviour relate to each other. These relationships should be fleshed out and closely investigated. From our experience is close examination of the relationships between formal game elements a key element in game design thinking. Students are often surprised to discover how relationships between objects, properties and behaviours are layered and how they interact with or depend upon each other to bring about player experiences. When these layered relationships are properly understood a clear understanding of the system dynamics becomes possible. And it establishes a univocal point of departure for further game development and game testing. During these processes students not only learn the importance of game testing, but also how to rigorously test each formal game object and its properties and behaviour and relationship to other objects. All done in incremental steps where each object is clearly fleshed out and tested. Such could how many times player one in *Oil Crisis* (http://op.tek.sdu.dk/?paged=2) should shoot soap on the beach to clean it in relation to oil spills from oil rigs. Determining the precise relationship between the two demands game rigorous game testing.

The *second* aspect evolves around game-balancing and finding more than one way to win (Sirlin, 2008) in order to both create meaningful choices (Salen & Zimmerman 2004) and generate strategic thinking (Crawford, 1982). Game-balancing have to do with balancing relationships so that, in multiplayer games, both players find both have viable options the find the game fair. Viable options essentially deals with player choices. Giving players more than

one real choice (Sirlin 2008) paralleled with more than one way to reach the goal(s) (Crawford 1982). Taken together viable options and fairness generate strategic thinking since players have to consider which strategy to follow in order to achieve the desired goal. It is important (in multiplayer settings) that goal, choice and strategies seem fair in a way that it should be just as easy or just as hard to play either side of the opposing forces in the game. Fairness and game mechanics are closely related since it is essential that either player feel that there is no over-powering move in place. In order to flush out existence of over-powering moves Sirlin propose an analytical model that he calls *Yomi Layer 3*. It is an analytical instrument to spot imbalance whereby making it possible to balance moves between players in the game system. *Yomi Layer 3* is an investigation of the relationship between moves and counter moves. If there is no move in place to counter an attack you have an overpowered move. If you want to strengthen strategic thinking a counter move should be designed. To go even further Sirlin proposes a move to the counter move thereby introducing the need for yet another counter move.

All in all Sirlin proposes how a good move (player 1 attack) should be followed by a counter move (player 2 defend) followed by an attack from the defender (player 2 now attack) and a defending move (player 1 now defend player 2's attack). Closely analysing this circle of moves between attack and defence makes it possible for designers to properly understand and balance their game. Once again game test play a crucial part in flushing out overpowering moves or missing counter moves which otherwise would propel feelings of unfairness and uneven distributed choices which lead to rejection of the game. In *Oil Crisis* it is important that the move "oil crisis" is tough enough to stress the other player yet at the same time giving the other player a possibility to respond to the threat.

It is particular important to balancing asymmetrical games since they deploy different game mechanics, strategies and/or goals. Single player game balancing has to do with objects and AIs and less about uneven distributed choices and strategies.

The *third* aspect is concentrated on reward structures (Yee, 2014; Juel Larsen, 2012; Hopson, 2001) and how to use them as an integral part of the game design. Reward structures are typically, as Hopson have clearly illustrated, divided in ratios and intervals which both can appear fixed and varied. Fixed ratios have to with rewards appearing after a certain time or after a specific player action. Fixed ratios are predictable. Players can determine when a reward will appear and devise strategy accordingly. Variable ratios are inherently unpredictable. Players are uncertain as to when a reward will either appear in the game or when a reward will present itself on account of player activity. This present game designers with a toolbox consisting of predictability and uncertainty in relation to player choices. Should players choose one reward over another or visa-versa? Presenting players with different reward structures adds to the strategic complexity of the game. And give designers different ways to engage players and support continuation desire. Should players be offered rewards on the basis of activity or time or even place.

Reward structures incentivise game designers to explore not only rewards in relation to objects, choice and strategy, but also to make good use of the entire game space (Aarseth 2000). This is done addressing rewards by where they reward in the game. Rewards is also a good way to, in a measured way, introduce imbalance in order to at certain times or after particular actions give one player a slight advantage over the other. Reward structures therefor present a highly dynamic way of designing levels by shaping the game space and handling internal relationships through predictability and uncertainty.

In *Oil Crisis* is do sailing oil barrels from oilrigs to the market place give rewards in shape of money. Which in turn can be utilised put the other player under pressure. Reward and system relation work close hand-in-hand.

The *fourth* aspect of game-feel (Swink, 2009) takes into consideration the development of a responsive and fluent environment. Swink defines three building blocks of game feel. The *first* is *real-time control of virtual objects*. It deals with interaction between player input and game response to ensure precise continuous control in order to produce aesthetic player sensation. The *second* addresses simulated space, which is concerned with the relationship between controllable objects (avatar) and objects of the game world and how they interact. Simulated space does in this respect underscores "tactility" in the game world. How are objects materiality communicated? Are they heavy or light, easy or difficult to destroy, hard or easy to kill? The overall question is which sensation do game designers want to distribute to players? The *third* building block of game-feel is polish. Polish is closely connected with the *fifth* dimension called juiciness (Juul, 2010; Jonasson & Purho, 2012). It deals with how relationships between controllable object and the environment are communicated: do the object slide or crash into stuff. Are their particles when objects collide, when a character walk or run. Do the game use camera shake, pushbacks, lighting and sound effects to underscore actions in the game world? When the fourth and fifth dimensions are taken together they work with players perception of the aesthetic fluency of movement and the "tactility" or "physicality" of in the game world. Both present designers with options to think about game design that goes beyond listing formal elements, system dynamics and balancing difficulties. Polish and juiciness is far from just graphics. They communicate the game. Without good communication the player looses interest in the game. In *Oil Crisis* do highlighted credits over the beaches communicate to the player how much money he/she gets, but also how many shoots is still needed to clean the beach. Both of which is highly relevant during gameplay. And an underlying theme to polish and juiciness is more, bigger and upward is good while less, smaller and downward is bad (Lakoff & Johnson, 1980). In *Oil Crisis* do the progress bar to the left get filled with soap from the bottom up, as the activist wins, while the oppressive power of the oil magnet press the soap down.

The *six* and final aspect explores the concept of feed-back (Adams, 2012). Feedback can be understood in two different ways. The first is concerned with amplifying responses with polish. Within this frame of thought feedback deals with communication. The second way is concerned with accelerating or decelerating system dynamic. Positive and accelerating feedback is about entering a positive upward circle where it becomes easier and easier to score or get ahead leaving the opponent behind. Negative feedback is the opposite effect. It makes it harder and harder to get back in the game. The downward spiral becomes faster and faster and the player looses more and more terrain.

The first way of understanding feedback is closely tied to communication emphasized by polish or juiciness while the second is deeply connected to game-balancing and reward structures. It is important for students of game design to understand feedback both as communication (that games are really all about communication) and as systems that reinforces certain choices in order to drive players in particular directions.

In Little Green Box designers embedded the accelerating and decelerating feedback aspects in their game design. They made three areas on the screen: 1) nobody got any points, 2) player 1 got points and 3) player 2 got points. Thereby not only making dynamic shift between competitive and co-operative play, but also making sure neither play entered a downward spiral that would make it impossible to get back in the game.

Taken together do those six aspects create a pedagogical matrix for game design thinking. All six aspects constitute or bridge vast areas of game design. Putting these six aspects together makes it easier and faster to grasp central and important dynamics of game design while bridging crucial perspectives that should be taken into account when designing games. In this way do these six aspects open venues for thinking about games.

PROBLEM-BASED CREATIVITY AND FORMAL GAME ELEMENTS

Problem-based creativity rests on an insight that framing creative can be compared to mini-games in the game design processes especially when compared to the catalogue of formal game elements. Like multiplayer games do game design creativity spring from design *goal*, *challenges* (what needs to be overcome), *conflict* (if we do one thing it gets in the way of already done stuff etc.) and have participation from one or more *participants* (players).

The challenge revolves around a clear design goal (for clarity we have disregarded borderline game cases (Juul, 2003) or as Burgun (2013) understands games when he differentiate between interactive systems, puzzles, contests and games where games are all about *decision making*) with a *variable outcome* or creative solutions. Like challenges in games have variable outcomes so do design challenges. In computer games do challenges often represent conflicts with several possible meaningful sets of choices the same goes for the creative process in game design.

The structure of creativity in the design space behaves like a challenge in a game. It has participants like players in games; it has a built around a conflict (problem), clear goal (desire to solve the conflict and reach a desired goal) and a variable outcome (different solutions). Both game and the creative process can be regarded as governed by rules.

Stated this way design challenges work like mini-games making it fun to create solutions. We have chosen to regard problem-based activities in the game design process as mini-games. We call playing them problem-based creativity due to fact that it brings about surprising and innovative outcomes.

EVALUATING OUTCOME OF THINKING AND PROBLEM-BASED CREATIVITY IN THE DESIGN SPACE

One of the many difficulties in game design has to do with evaluation of the outcome of either game design thinking or problem-based creativity within the design space. Establishing a clearly framed point of departure students can evaluate there design thinking and their design solutions. It should be underscored that framing works both in conjunction with thinking in the design space and in relation to the outcome of the problem-based creativity. This brings precise framing front and centre of the entire game design process. In this way do framing (1) establishing the point of departure for the game design process in its entirety, (2) works as a as a guideline for game design thinking, (3) help frame challenges for the problem-based creativity and (4) acts as an evaluating tool for the outcome of design thinking *and* problem-based creativity.

SUMMARY AND PERSPECTIVES

In this abstract we have presented the notion of game design space. It is based on research conducted in parallel with lecturing game design courses at our university. The notion aims at securing a dual ambition. The first ambition is to present a clear and straightforward overview of the game design process. The second is concerned with making sure students learn to think; act and become game designers.

The *first* part of our notion of game design space evolves around framing and it rests upon a player centric approach to game design combined with insights into game mechanics. The *second* part describes how thinking in the game design space can be constructed from six essential game design parameters; formal game elements, game-balancing, reward structures, game-feel, juiciness and feed-back. Together these parameters shape a matrix for game design

thinking. It can be exchanged when designing other kinds of games like story based adventure games. The *third* part relates the practice of solving problems during the design process. The *fourth* part returns to framing but this time using it as a guideline for evaluating the outcome of game design thinking and measuring creative solutions.

Our notion of design space sums up the essential perspectives on game design and it process in an educational setting and it holds promise to an easy way to understand and structure game design processes from beginning to end.

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