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The Canvas-Oriented Formalization of the Game Design Processes

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Abstract—The article proposes an canvas-oriented approach to game design. It justifies the applying of a dynamic cycle of interconnected canvases into creative game design, for the purpose of documenting the progress and results of the creative process, stimulating it while canvases simultaneously are both clues and guides in game development. The author's definition of game design canvasation as a process of creation of a visual abstract structure that generalizes the case goal (the task containing the accumulated experience) for achieving it and creating a unique creative product is given. Projects «Canvas of Player Psychotypes & Aethetics», «Canvas of Player's needs in Control, Information and Action», «Canvas of Game Mechanics & Dynamics», «Canvas of Narrative», «Canvas of the Game World», «Canvas of Game Level» «Canvas of Ethical Dilemma» are presented. Canvases structure the game development process, reduce the time taken to generate game designer ideas and to contrive game mechanic and dynamics. Canvases are an additional road map toward making creative decisions in game design. They can be a convenient basis for automating the process of latter, a paper prototype of the game and the game design as a quest process provided that each canvas is a location with quest tasks, the variability of which depends on the potential and attitude of the leader and team. Subsequently, it is planned to develop algorithm for routing the components of the canvases also will be developed, allowing to automate the process of filling out sections of the Game Design Document.

Keywords—*canvas-oriented game design; gamification; creative product; automation of the creative process*

I. INTRODUCTION

Is it possible to formalize and automate the creative process of concept development of computer game? How useful is this? Will the creativity help or kill this process? Under what conditions will formalization of creativity be effective? We are trying to answer these questions in this article. It is important to note that the topic raised should be viewed from the point of view of the irreversibility and exponentiality of the development of the informatization process as a new highly automated information environment that is formed through the use of information technologies and the modernization of all spheres of social life.

Game design is a complex multifarious and multistage creative process that includes the founding of a creative (innovative) idea and a business plan, the combination of such activities as testing, monitoring and project management and the implementation skills. Creativity depends on the aptitudes of individuals and organizations involved in creating a gaming product: ingenuity and the ability to find solutions; willingness to take risks and look at the problem from an unexpected angle; interest in

experimentation; ability for reflection and continuous learning [1, 2, 3].

It should be noted that the concept of «canvas» as a method of visualizing and structuring thinking and knowledge is not new [4; 5, 6]. In historiography there are actively developed methods for mapping data and knowledge [7], infographics [8]. Game Design Canvas (from French word «Canevas» - a sparse, reticulate, usually starched fabric for embroidery across the cells; the framework of something) is understood by us as a visual abstract structure that generalizes a case subject consisting of such elements as a problem, solution and consequences, and contains accumulated experience. Canvases filled with specific content (ideas, facts, assumptions, feelings, actions, descriptions, etc.) make it possible to effectively solve the task and create a unique creative product. By this, Canvas differs from Template, since the latter does not imply variability and creativity. The template is focused on producing the identical products, whilst in contrast canvas implies the creation of various original projects. Canvas includes templatization as a framework and elements of almost all visualization methods (creative freedom) [9].

Canvasation tools are images and notes on stickers and cards attached to charts, grids, tables, matrices, affinity diagrams, clusters of ideas, patterns, maps, algorithms, ratings. Nevertheless, the method of constructing and reading the canvas is different from, as example, knowledge maps. The point of departure for mapping is generally the center (the main concept), whilst the design of the canvas is determined by the essence, structure and logic of the case task: it starts from the end - understanding the goal - to a tangible state. The logic of canvases reading depends on the mechanism embedded in them: bottom-up-right, if the axis of coordinates of time and significance is important; from chaos to or-dering, if based on clustering; clockwise - to describe and analyze the object as a unitary system; etc.

The canvases of game design comprise the characteristics of knowledge cards, since they allow to present quite complex concepts in the most intelligible combination of elements and imageries of the game knowledge system (ideas, tasks, process, etc.), make it possible to cover the situation as a whole, as well as to keep in mind simultaneously a large amount of information in order to find connections between individual parts, find the missing elements, memorize information and be able to reproduce it even after a long period of time. However, in contrast to knowledge maps, canvases are not only a means of understanding complex processes, but also peculiar routers in the process of achieving goals. In other words, the knowledge maps and infographics mainly perform an

explanatory function (comprehension, awareness, vision, memorization, logging), whereas the canvas stimulates the function of constructing the rules of the game world, levels etc.

Creating the canvas as an information model of a computer game, filling it up as a result of making a creative decision correlates with the essence of creative thinking as a processes contributing to the generation of innovative problem solutions [10], as the kind of thinking, which best produces creative results [11].

II. RELATED WORK

The issues of optimizing game design processes by the instrumentality of visual tools have been examined since the theoretical development of MDA [12] and DPE [13] models as game analysis tools. At the same time, these models were the basis for the development of computer games. Meanwhile the features of the canvas language were studied [6]. Visual game design methods as brain-storming technique were presented in the book [5]. Inter-estingly enough that all forms of visualization of thinking in the process of designing business processes are called «game» by the authors. The latter consists of such important elements as [5]: Game space (conventional topos, agreement-based topos), Boundaries (game chronotop), Rules for interaction, Artifacts (maps, playing dibs, dices, stickers with notes, all tangible movable objects contain-ing information) and a Goal. The main stages of activities of the game designer in this case are: «imagine the world», «create the world», «open the world», «explore the world» and «close the world». Depending on the game designer's idea, actions can be single, cyclic, parallel, and serial.

The development of design patterns as a single tool and integration language for game producing is one of the top themes in the industry-specific community [14, 15, 16, 17, 18]. Nowadays, such scientific Internet platforms as Academia.edu and Scholar.google comprise more than 348 thousand and 3.6 million publications on the problems of game design templization respectively. At the same time, scientists are considering the question: what should be the basis of the game design pattern? Different starting points are proposed for the development of such canvases: classification of serious games [25], project activity [5], game design patterns [17], player profiling and motivation [20]. As a result, it is noted the necessity of creating a database of project concepts [21]. At the same time it is important that attempts were made to automate the process of game design, to develop an intelligent system that generates computer games by modeling and generating game mechanics [22].

Today, there is a tendency to interpret game design as an automated process, which is based on the universal integrated pattern «Design Pattern Canvas». At the same time, superfluous abstraction of the game design canvas complicates the process of such automation, as it forms only a superficial idea of the game project, limits the degrees of freedom of the game designer (the choice of game genre and aesthetics, the development of game history and rules, their balancing, level design), and narrows variability of creative solutions. It is reasonable to develop a cycle of interrelated canvases, corresponding to the stages of game design, and to detail them in the shape of sets of case diagrams and guide

notes, which will later allow to structurally formalizing the process of games producing.

Therefore, the purpose of the research is to identify the features and advantages of using a series of intercon-nected canvases for designing computer games, which will automate the process of creating the Game Design Document.

III. THE CANVAS-ORIENTED FORMALIZATION OF THE GAME DESIGN PROCESSES

In our works [9] we proposed a series of canvas in game design, based on MDA & DPE models [12], as well as the principle of “experience” or creative case-problems of the development stages of computer games:

- 1) Studies of consumers as a players:
 - Canvas of Business Model [23];
 - Canvas of Empathy Map [5].
- 2) Studies of the aesthetics of the game based on the needs of the player:
 - Canvas of Player Psychotypes & Aethteticts
 - Canvas of Player's needs in Control, Information and Action.
- 3) The MDA-components of «Game Mechanics» and «Game Dynamics» include:
 - Gamification model canvas [20];
 - Canvas of Game Mechanics & Dynamics;
- 4) Research and design of the game world:
 - Canvas of Narrative;
 - Canvas of Game World;
 - Canvas of Game Level;
 - Canvas of Ethical Dilemmas.

Figure 1 presents only modified or new proposed canvas.

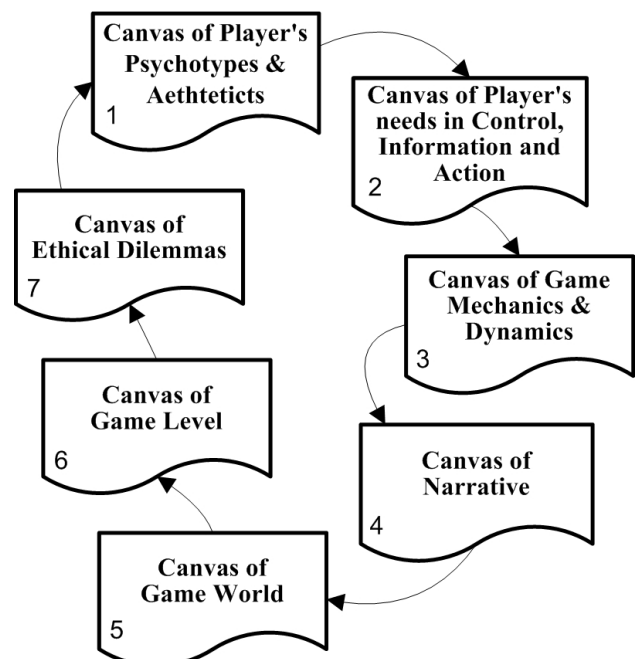


Fig. 1. Series of Canvas for Game Design

Canvas of Player Psychotypes & (game) Aethteticts - the canvas of the correlation the players psychotypes with the desired emotional reactions that should be caused by the dynamics of the game. For the design of the canvas, 8 components of the game aesthetics [12] were used, as well as

the taxonomy of player types [24], elements of the theory of entertainment (fun) in learning [25]. On the canvas the personality types and components of the game aesthetics are detailed and grouped according to the proximity of their characteristics, but the canvas does not limit the interaction of its components, stimulating unexpected creative solutions. The canvas offers the game designer a choice of the target audience, aesthetics and entertainment components (fun), filling the corresponding canvas cells with his vision of these elements. The combination of choiced components gives rise to the general idea of the game. For example, the player «Creator-Explorer» in accordance with the aesthetics of «Challenge» and «Easy Fun» will form a game competition for the speed of searching and creating artifacts. The identified key characteristics of the consumer are the basis for building maps that allow to explore and create the aesthetics of the game.

In the case of designing educational games, the choice of the prevailing aesthetics is not determined by the results of testing and the player's psycho-type examination, but with regard to goals and subject area of the discipline. If one of the goals of the training discipline is to form communication skills, then the game designer needs to choose the type of «Socializer», Aesthetics of «fellowship» and «social» fun. Canvas of Player's needs in Control, Information and Action determine the choice of a computer game genre based on studies of the classification of game genres [26].

The above mentioned canvases lay the foundations for the subsequent character creation and game history

Gamification model canvas [20] gives an overview of game.

Canvas of Game Mechanics & Dynamics presents game mechanics and dynamics as a formula consisting of elements of mechanics (actions, chances, win conditions and bonuses) and control forces of dynamics (rules, time, statistics, balance). This Canvas, in our opinion, is one of the most difficult to visualize, since the very concept of «dynamics» in the game community is not clearly and broadly defined. In general terms, dynamics can be understood as an instrument of aesthetics, creating a feeling of the game, as the process of the game itself and the game «session», as the behavior of the game as a system; as the rules of the game, which are used in the movement (campaign, process, sequence of turns); as a set of game mechanics created to form a certain result; as triggers that determine the players behavior and the players own actions, as the strategic way of application of the rules and known combinations in the game. Proceeding from etymology of the Greek word δύναμις («strength, power»), by the term «game dynamics» we mean the state resulting from the interaction of the game mechanics. Therefore, the dynamics can not be considered in isolation from the game mechanic.

Canvas of Narrative allows to create and develop the plot of the game. The basis of this canvas was taken by the empathy map canvas, but the content of the canvas was thoroughly revised in accordance with the cultural and structural-semiotic studies of literary and folklore texts, the theory of cultural universals and the mechanisms, concepts of C.-G. Jung, V.Ya. Propp. Canvas of Game World helps to visualize and plan the physical world of the game. This Canvas gives game designers the opportunity to explore the

game world. Canvas of Game Level gives game designers the opportunity to explore and design the levels of the game

Automatization of process of computer games development is seen by us through the formalization of the connection of the cycle of canvas of design game in the form of formulas.

It seems promising to use a series of canvases for gamification of the game design process provided that each canvas is a location with quest tasks, the variability of which depends on the potential and attitude of the leader and team. In such a case each cell of the canvas is an object for the game designer's mechanics, and the variants of the game design solutions can be the result of a carefully considered choice of characteristic combination within the canvas and the result of randomness mechanics by using dices and playing cards with content of the canvas.

The final and verifiable canvas in the process of canvas-oriented game design is the canvas of Ethical Dilemmas.

Canvas of Ethical Dilemmas to regulate the game with regard to balance and ethics by detecting deficiencies in the gameplay components, controlling the achievement of the necessary aesthetics and solving ethical conflicts, adjusting feedback between channels so that, ultimately, create socially useful human oriented product. The algorithm for routing the components of the canvases also will be developed, allowing to automate the process of filling out sections of the Game Design Document.

The theme of good and evil is one of the oldest basic topics in philosophy, aesthetics, religious studies and folklore. Evaluation of any categories of moral consciousness, and of all phenomena of Being, in one way or another, leads to arguments of God's justification (Christian medieval concepts of Aurelius Augustine [27], Thomas Aquinas [28]), defining the role of evil in the world of spirituality (Western Europe GV Leibniz [29], I. Kant [30]). The paradigm of binary oppositions in the understanding of good and evil is overcome in the work of geniuses of the twentieth century - J.P. Sartre and F. Nietzsche [31]. So, J.P. Sartre [32] declares recognition of a person's personal responsibility for everything that happens in the world, F. Nietzsche rejects the absolute of the forces of good and evil, denies the fact of universal morality.

Creating the Canvas of Ethical Dilemmas of game design was dictated by Sartre's responsibility to the descendants of the information society and the need to create socially useful products. Therefore, the structure and content of this canvas are inspired by the above concepts. The requirement of formalization of complex moral and ethical dilemmas led to the use of the foundations of semiotics, C. U. Morris, R. Jacobson, F. de Saussure, G. Frege. In this sense, the game acts as a system of signs, the properties of which are found in «relational relations» acquired by objects in the functional process of semiosis" [33].

The analysis of the ethical dilemmas of the game will be based on the logic of the semiotic chain proposed by R. Jacobson: sign - context - meaning - addressee. Each game object is a sign that in the specific context of the game narrative and player experience expresses meaning (meaning different connotations in terms of additional emotional, evaluative, stylistic meanings of an object or phenomenon).

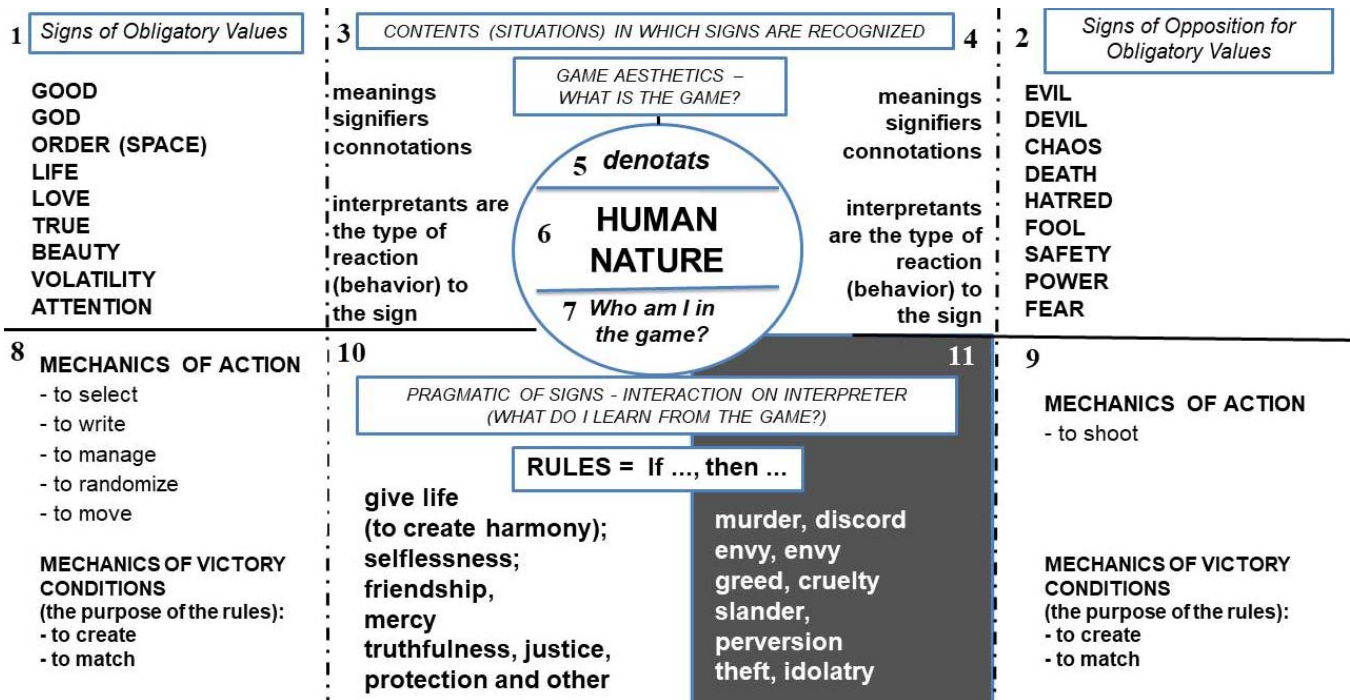


Fig. 2. Canvas of Ethical Dilemmas

The canvas is segmented by three levels of C. Morris semiosis [33]. Sectors 1, 2, 8, 9 refer to the syntactic level of semiosis - they imply a formal relation between the characters of each others. Sectors 3-7 represent the semantic level of semiosis and reflect the relationship of signs to their objects. Sectors 10, 11 represent the pragmatic level of game analysis — express the relation of signs to interpreters. In the DPE-model [13] correspond to the element "EXPERIENCE".

The structure of the canvas consists of the following elements. Sectors 1 and 2 - signs of obligatory values and their opposites. These are the binary oppositions of the "pure ideas" of absolute forces ("good - evil", "good - bad", "order - chaos", "life - death", "perfection - imperfection", "harmony - disharmony", "being - non-existence", "righteousness - sinfulness", etc.). Sector 3 and 4 are the meanings of characters acquired in game contexts (game narrative). These are not the game objects themselves (characters, things, etc.), but their perception by a person — significations and designatories, connotations, and also interpreters as types of reactions to signs. At the same time, sector 3 includes all positive meanings, and sector 4, negative ones. We are talking about situations where the signs of good in the context leave their moral properties or acquire the meaning of "evil" and vice versa. Sector 5,6,7 - denotates of game characters and objects. According to the theory of signs of Morris is defined as a denotative realistically existing object of reference [Morris, 41]. These are objects, things, objects and phenomena of objective reality, replaced by signs. Thus, sector 6 is man (real or imagined) and natural phenomena (real plants and animals). Sector 5 includes all other denotats: technology, facilities, monsters, etc. Sector 7 - the image of the character-hero, for whom the player plays. This distinction was introduced by us a priori, since we are convinced that the axiological world of the game should be focused on man as the highest value. At the same time, if the game is played in the first person and the main character is an animal (sector 7), an ethical conflict arises - the animal hero cannot apply the mechanics of sectors 2 and 9 to the

person-character. Vivid examples of the violation of ethical balance are games like "Shark Simulator", "The Evolution of a Hungry Shark", in the cartoon "Peter Rabbit" (USA, director Will Gluck). Sectors 8 and 9 are "pure" game action mechanics, distributed among binary oppositions. Sectors 10 and 11 - the pragmatics of signs as a result of the mutual influence of the mechanic and the narrative of the game? These sectors formalize the effects of the game: what does the game teach? What experience does it create? What motivates the player? What feelings, thoughts, desires and actions models? Pragmatics sectors show what the final role of good and evil in the game is, for example, can certain signs in the category of "evil" clean up? Is fear useful? Does "love" create "enmity"?

The prohibition function in game design is recommended if, as a result of the interaction of the mechanic and narrative (context), sector 11 is implemented (in the outline highlighted in black). And also, if interaction of sectors 4 and 6 occurs, and opposition of sectors 6 and 7.

IV. IMPLEMENTATIONS

Game «Chocolate math» of M. Arest is meant for children of pre-school and young school years; Goal of game is learning multiplication tables from 1 to 9. Game based on economic mathematics — that is, the purchase of chocolate pieces. The child is introduced to the conditional degree - one part of the chocolate that costs one coin. The child then has to intuitively figure out how many chocolate pieces are contained in the proposed whole chocolate tile. Thus, the child develops an observer, assimilates the principle of division (part-integer), seizes the digit of numbers (units, dozens). The game has training and control modes, difficult levels depending on the assimilation of the multiplication table.

Canvas of psychotypes of players & Aesthetics:

- Player type - "Creators", "Seeker".

- Aesthetics component - "Discovery".
- Fan - "Heavy".

Canvas of Player's needs in Control, Information and Action:

- NI1, NI2, NI3.
- Genre - quest, puzzle.

Canvas of Game Mechanics & Dynamics:

- Action mechanics - searching for a correct answer.
- Mechanics of victory conditions - resolving all the issues, discovering all the primary elements.
- The Mechanics of luck - hints.

Canvas of Narrative:

- The Plot type – nonlinear, concentric, with clear causal linkages between episodes.
- History - the hero (child) travels to different cities and famous world markets, buys chocolates in order to create different chocolate dishes for a party of friends. The hero is accompanied by various assistants (animals) who give hints. However, there are also such heroes who interfere with the hero (for example, pick up chocolate bars). Travel motives (like player progress in the game), competitions, story-locations (for example, "World Markets": Agora of Ancient Greece, Grand Bazar in Istanbul, Camden in London, Khan al-Khalili in Cairo, Bokeria in Barcelona, etc.).

Canvas of Game World:

- Game World - culinary world.
- Locations - the places of life of famous bazaars.
- Player progress is shown by his place on the map, the number of primary elements discovered.

Canvas of Game Level: the player progress is shown by his place on the map, the number of chocolate bars bought and the dishes created. *Canvas of Game Level:* the player collects "chocolate awards" for dishes and "likes" from friends who have attended his parties. In the future, a social fan and the need for control will be added: NC1, NC2 Economic Strategy. At the first stage, it is enough to show the most popular chocolate pieces and their monetary value. However, as the complexity of multiplication tasks is appropriate, it is necessary to connect narological elements that would make the complexity of the task and the uniformity of the actions performed. Enrichment and complication of the game world provides immersion in the game, the motivation of the player to her conduct, creates the necessary mood for the game (fun).

The game enriches not only the visual elements, but also expands the subject field for learning (various national measures of weight and currency, history and customs of different countries, etc.). The series of proposed canvas allowed to create a non-technical part of the game project. Later the game as a software product was described using UML-diagrams. Figure 3 presents a description of the game project based on UML-diagram of precedents.

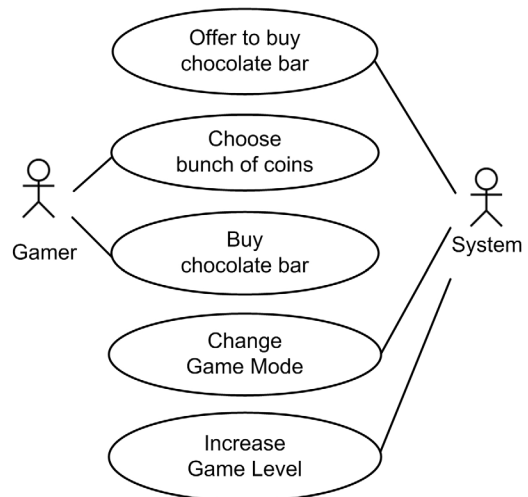


Fig. 3. Description of the game project based on UML-diagram of precedents

Figure 3 presents a description of the game project based on UML-diagram of conceptual classes.

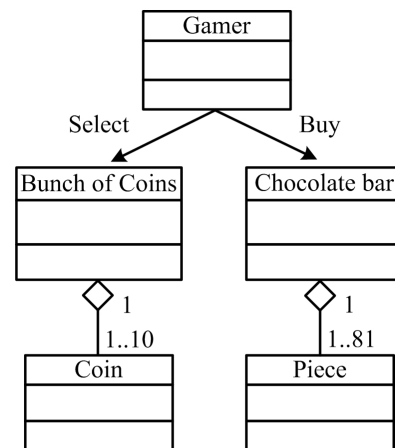


Fig. 4. Description of the game project based on UML-diagram of conceptual classes

In the process of Game Development was used the MIT App Inventor as block visual programming tools for Android-smartphone [34]. The prototype of the game "Chocolate Mathematics" was created by schoolchildren during a free training session at the Institute of Computer Systems of the Odessa National Polytechnic University [35].

Figure 5 presents screen example for prototype of computer game.

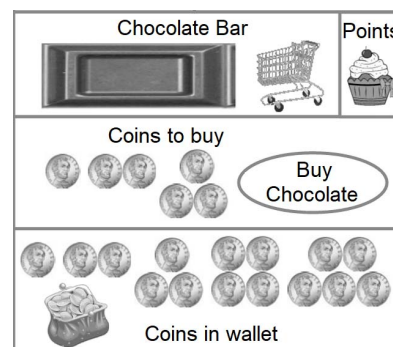


Fig. 5. Screen example for prototype of computer game

V. CONCLUSIONS

The proposed series of game design canvases is a kind of springboard to rising the intuition and creativity of game developers. It could be used in individual and group work as a tool for cooperation. Canvas document the progress and results of the creative process, stimulate it, while being both clues and guides in game design. In this case, the canvases correspond to the principles of visibility and intuitive clarity, conciseness, renewability, transparency and variability. They structure the game development process, reduce the time taken to generate game designer ideas and to contrive game mechanic and dynamics. Canvases are an additional road map toward making creative decisions in game design. They can be a convenient basis for automating the process of latter, a paper prototype of the game and the game itself.

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