CARD GAME BASED LEARNING IN FOOD SAFETY AND NUTRITION EDUCATION

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Annotation

This paper presents an educational constructivist computer card game approach for the learning of food safety and nutrition concepts by pre-primary, primary and secondary level students. This approach adopts a "7-step modeling methodology" for constructivist computer card game design (Kordaki, 2015). The design framework of a 10-level Educational Computer Card Game (ECCG), based to the aforementioned methodology, is presented in this paper while an example of a specific card game referring to the Food Pyramid is also demonstrated.

Key words: *card game based learning, food safety, nutrition, education, constructivism.*

Introduction

Games are multi-dimensional structured entities that enable players to participate individually or in teams, in voluntary, competitive, physical or mental activities involving challenge and fantasy elements, following specific rules and restrictions in order to attain a goal - specified by the game itself – and finally leading to a quantifiable outcome (Asgari & Kaufman, 2004; Charsky, 2010; Dempsey, Haynes, Lucassen, & Casey, 2002; Salen & Zimmerman, 2004; Zyda, 2005). Learning, on the other hand, is an active process in which learners develop their own understanding by assembling facts, experience and practice (Jonassen, 1994). Thus, games have been suggested as potential learning environments because they have characteristics that are related to the way people learn, namely: activate prior knowledge, context, feedback and assessment, transfer, experiential, and social (Oblinger, 2004). Hence, strategic thinking, planning, communication, application of numbers, negotiating skills, group decision-making, and data-handling are valuable skills that are being supported and developed by game-play (Kirriemuir, & McFarlane, 2004).

Computer games are part of our social and cultural environment (Oblinger, 2004), and have also become powerful contexts for learning by facilitating people to participate in new worlds by thinking, talking and acting at the same time taking roles inaccessible to them in other learning contexts (Shaffer, Squire, Halverson & Gee, 2005). Challenge, curiosity, fantasy (Malone, 1980), control, and feedback (Malone, & Lepper, 1987) are also essential characteristics of computer games that could enhance people's motivation and engagement. Actually, the following essential characteristics of computer games have been suggested to support players' engagement in game-play, namely: fun, play, interactive, adaptive, rules, goals, outcomes and feedback, win, conflict/competition/challenge/opposition, problem-solving, interaction, representation and story (Prensky, 2001).

Educational computer games are thought to be effective tools for teaching hard and complex matters, because they have characteristics that could support: (a) the use of learners' action instead their passive attention of their teachers' presentations and explanations, (b) personal motivation and enjoyment, (c) multiple learning styles and skills, (d) the reinforcement of essential mastery skills, and (e) interactive and decision making contexts (Kebritchi & Hirumi, 2008). The abovementioned characteristics are aligned with the social and constructivist views of learning (Vygotsky, 1980; Jonassen, 1999), where knowledge is not directly transmitted, but it is being actively built up by learners who are based on their experiences and interact with their environment or culture. Thereby, knowledge construction can be promoted within constructive, collaborative, conversational, reflective, contextualized, complex, intentional and active contexts (Jonassen, 1994).

Furthermore, card games (CGs) are simple games (Crawford, 1982) that can be easily integrated by the teachers into the teaching process since teachers are accustomed to this kind of games. As far as the learning perspectives are concerned, card games improve communicative skills and promote active learning through interaction with other players (Bochennek, Wittekindt, Zimmermann, & Klingebiel, 2007). In addition, the enforcement of matching, number manipulation and pattern recognition skills is being promoted (Van Eck, 2006), while the players' logico-mathematical and interpersonal intelligence are also encouraged by card game play (Berger & Pollman, 1996).

Educational non-digital CGs have been designed to supplement the learning of various subjects included in the school curriculum, such as: Computer Science, Physics, Mathematics, Language, Food education, and Teacher education, etc. (Kordaki, 2011; Klonari, & Gousiou,

2014). Educational Computer CGs (ECCGs) have been also designed to support the learning of diverse subjects while in several ECCGs new modalities of interaction support the emergence of further perspectives for learning and e-learning. Additionally, innovative pedagogical approaches were taken into account in the design of several ECCGs which seemed to contribute to knowledge construction by the students (Kordaki, & Gousiou, 2014).

Based on the above, this article proposes a game-based approach on "Food Safety and Nutrition Education". This study is realized within the context of the *"Let's make it better! Raising the awareness of the triad nutrition-health-food safety in school education (EduForHealth): 2014-1-RO01-KA200-002931"* European Project. The general objective of the project is to restore the place of the life sciences (oriented on nutrition and food safety education) in the culture of the young people. Thus, in order to reinforce the importance of nutrition and food safety education insight school and after-school tasks, teaching and learning activities will be focused on motivation and ability of young people to make healthy choices and to develop a real culture for a healthy life, on long term contributing to a cohesive society.

Specifically, 10 essential topics will be initially distinguished – according to the literature of food safety and nutrition – for primary and secondary education level. Based on these essential topics, a game-based approach will be suggested in order students: (a) to be aware of their misconceptions and inappropriate behavior regarding nutrition, health and food safety and receive appropriate feedback, and (b) to acquire basic knowledge about nutrition, health and food safety and verify conclusions previously presented by textbooks and teachers. Virtual laboratories in the form of intelligent digital card games and intelligent digital stories will aid students to verify their knowledge about the abovementioned matters through active game play and appropriate feedback will be provided to students to correct their misconceptions.

To this end, this article suggests the design of a 10-level ECCG, one for each of the said essential topics, to support pre-primary, primary and secondary education pupils and students in terms of food safety and nutrition awareness. The remainder of this article is organized as follows: first, the significance of food education will be discussed. Next, the design framework of the suggested ECCG will be described, followed by the presentation of an example of an educational card game for the learning of the Food Pyramid that is one of the said ten essential topics. The paper ends with a summary and future research directions.

The significance of food education and the "EduForHealth" project

The quality of life is strongly related to healthy development and healthy behaviors during all life stages. Despite a lot of efforts made insight the European education, a real need remains to improve the scientific literacy for all students in order to be able to interact, in a dynamic manner, with the world subjected to continuous changes. Hence as adults to form attitudes and become part of decision-making processes.

In fact, nowadays, a dramatic shift has occurred, in stages, regarding the way people eat, drink, and move, and these changes have opposed with human biology to create major changes in body composition (Popkin, Adair, & Ng, 2012). It is also noteworthy that one of the biggest matters today is childhood obesity; last decade, approximately almost 20% of youth aged 6 to 17 are considered obese (Federal Interagency Forum on Child & Family Statistics, 2009) while obesity rates for children aged 6 to 11 increased with ascending rates. Besides, research shows that obese children have an increased risk for health problems and are more likely to become obese adults (Centers for Disease Control, 2010).

Moreover, despite the efforts made by policy makers inside the axis health - food, numerous scientific papers related to school children education draw a warning to the fact that a significant proportion of teens and adults have never learned the basic principles of food safety, as consequence being unable to protect themselves and their future families. A lot of explanations are identified, the main being the reduction or elimination of specialized courses from school curriculum, respectively the increasing of the convenience of consumption partially or fully prepared foods due to societal changes that have as consequence the mothers employment outside home. Thus, unsafe food handling could generate risk for food borne illnesses. To this end, an effective educational intervention starting even at the pre-primary level and the reinforcement of parent education are being necessary with a view to diminish this risk.

Taking into consideration the abovementioned issues, the "EduForHealth" project attempts to address the education for health from the scientific, pedagogical and legislative perspective, taking also into account the age of children, the classroom level, the psychosomatic development of students as well as the national and local particularities. From the teachers' perspective, they could be trained to better expand the current educational step by deploying an integrated approach in the teaching of food science, by exploiting traditional and web-based materials, as well as by adopting modern teaching approaches such as game based learning and digital storytelling.

Thus, in the context of this project, teaching and specific learning materials will be designed with a special emphasis on the field of nutrition and food education. To this end, ten essential topics of Food Safety and Nutrition have been selected – according to the literature – as appropriate for pupils' and students' healthy nutrition education at the pre-primary, primary and secondary educational level. These topics are presented below:

- The Food Pyramid and the basic composition of foods (glucides, fats, proteins, vitamins, minerals, biological active compounds).
- The role of nutrients in the human body function and in the human health status.
- The biologically active compounds of foods and their implication in health wellness and preservation.
- The risk of chemical substances in food consumption (e.g. heavy metals, pesticides, self-born toxins, industrial born poison, etc.) and their implication in health.
- The biological health risks in food consumption (e.g. pathogenous and adulteration microorganisms and microbiological toxins).
- Chemical and biological risks and their prevention.
- The nutritional food labeling.
- The concept of RDA (Recommended Daily Allowance) and consumption security.
- Health logos.
- Food Hygiene.

Based on the above, an ECCG is being designed, containing and handling the aforementioned ten essential topics of Food Safety and Nutrition. In the next section, the design framework of the suggested ECCG will be discussed.

A 10-level ECCG for the learning Food Safety and Nutrition issues: design framework

An interactive computer card game will be designed in an attempt to help students learn basic topics about nutrition, health and food safety in a pleasurable environment. In the design of this game, social and constructivist learning perspectives will be taken into consideration. Essential educational computer game design principles will be also considered. Specifically, the design framework of the said ECCG will be based on the 7-step model methodology for ECCGs (Kordaki, 2015), which will be briefly presented below.

Step 1 - Definition of the subject matter model and of the student model: At first, the learning subject to be learned by the students through CG-play as well as the basic tasks for them, have to be described and elucidated; which is actually the *subject matter model*. Secondly, the students' non-scientific conceptions, regarding the matter under discussion, have to be investigated; which is the *learner model*. The first step contains the definition of two pivotal models that could also be represented, in order to be more effective, in the form of a concept map.

Step 2 - Definition of the aims of the CG-play: The aims of the game should be clearly stated in this step, based on the design of the subject matter model as well as the learner model.

Step 3 - Definition of appropriate CG-play learning activities: The learning strategy used constitutes the main part of the learning model and it is being analyzed in this step. Based on various aspects of social and constructivist views of learning (Vygotsky, 1980; Jonassen, 1999) have to be taken into consideration the following essential issues: (a) the learners' motivation in terms of compelling learning activities, scoring mechanism, and competition possibilities, (b) learners' new knowledge based on prior their knowledge and misconceptions, (c) critical thinking skills being promoted by classification activities and appropriate questions, since classification activities are pivotal to CG-play. Here, it is worth noting that, classification is a universal learning activity (Bishop, 1988) which promotes critical thinking (Marzano, Brandt, Hughes, Jones, Presseisen, Rankin, & Suhor, 1988), (d) visual support in order to provide external support on students' mental conceptions, and finally, (e) scaffolding and proper help related to learners' actions in order to promote effective learning through CG-play. Hence, examples of appropriate learning activities are: card classification (containing matching, grouping, ranking, and comparing activities), asking/answering questions, rejection of non-appropriate cards, etc. Based on the above, a number of cards should be designed, to include appropriate categories of cards for the attainment of each learning activity.

Step 4: Definition of specific CG-play activities to help students overcome their difficulties: A number of card game-based activities should be designed in order learners' difficulties or alternative ideas for the learning of the concepts in question that have been defined during the first-step, to be overcome. For example, "challenging cards" could be designed, in order students' usual mistakes to be addressed.

Step 5: Definition of the kind of motivation that should be provided for students during CG-play: In order learners to be willingly engaged in card game-play, certain types of additional cards should be designed, as part of the deck, to support the card-game activity, namely: "motivation cards" and "joker cards". The connection of these cards with the scoring mechanism could also enhance the students' engagement.

Step 6: Definition of the kind of scaffolding during CG-play: The role of "scaffolding cards" is also crucial for the card game learning experience, since useful information is provided related to the concepts included in the subject matter model. Hence, a number of "scaffolding cards" should be designed, containing text/visual information, solved representative problems, etc.

Step 7: Definition of the rules of the CG-play: Finally, the game mechanics, including the goals, rules, winning strategy, type of interaction among players, outcomes and challenges of the CG-play should be regarded and clearly stated. Hence, appropriate "information cards" should be constructed.

Finally, it is strongly suggested, in a first phase, physical ECGs to be constructed and tested in the field using real students in order to take useful feedback and to make appropriate corrections and in a second phase implement the digital mode of these games.

The 'Food Pyramid' ECCG example

The aforementioned 7-step modeling methodology will be used in the design of a 10-level ECCG for the learning of nutrition, health and food safety. The example below describes the design of one of the 10 levels of the game which is related to the first of the 10 essential topics of Food Safety and Nutrition for school children that have been presented in a previous section of this paper (see section 2).

Step 1 - *Definition of the subject matter model and of the student model*:

Definition of the subject matter model: The ECG presented in this section is designed for the learning of basic concepts related to "Food Pyramid" by fifth grade pupils. The model of the *subject matter* consists of the basic concepts related to "Food Pyramid" Elements –as well as its optimal number of servings each day from each of the basic food groups, namely:

- *Grain*: Foods from rice, wheat, cornmeal, oats, and barley,
- *Vegetable*: Nutritious foods from the ground like broccoli, carrots, and lettuce.
- *Fruit*: Nutritious seed-containing foods like watermelon, pears, and pineapple.
- *Milk*: Low fat or fat free milk and milk products like cheese and yogurt.
- *Meat*: Lean beef, poultry, fish, eggs, and nuts.
- *Fats, oils and sweets*: Discretionary calories or a set amount of extra calories allotted for a person's daily diet.

Definition of the student model: According to the literature, students of this age have difficulties to understand the following essential concepts related to food nutrition: (a) fruits, vegetables and legumes are of significant importance; but they are being overlooked by students, (b) foods' origination, e.g. cheese is made from milk and not from plants or fish-sticks are made from fish and not from meat as many students wrongly believe, (c) sweets are a controversial issue, since parents usually use them as reward, although they know that they are unhealthy (d) food is the source of energy and vitamins are provided by them and not by pills, (e) cereals are a wide food category containing not just the morning cereals, (f) diverse fruits, vegetables and legumes should be consumed usually and not just one of each kind, and (g) each level of the "Food Pyramid" contains specific foods and anyone should be able to put diverse kinds of food to the right position. The abovementioned difficulties should be investigated in order to be surpassed during card game-play.

Step 2: *Definition of the aims of the CG-play*: In this step, the aims of the ECCG should be thoroughly defined taking into account the data emerged from the previous step. Consequently, an ECCG could be created to support students to: (a) learn to identify the food categories used in the food pyramid, (b) be able to complete a food pyramid by placing the correct kind and number of foods on each level, (c) learn about the nutritional value of basic foods, and (d) identify healthy, nutritious foods as opposed to unhealthy foods and be able to create healthy choices.

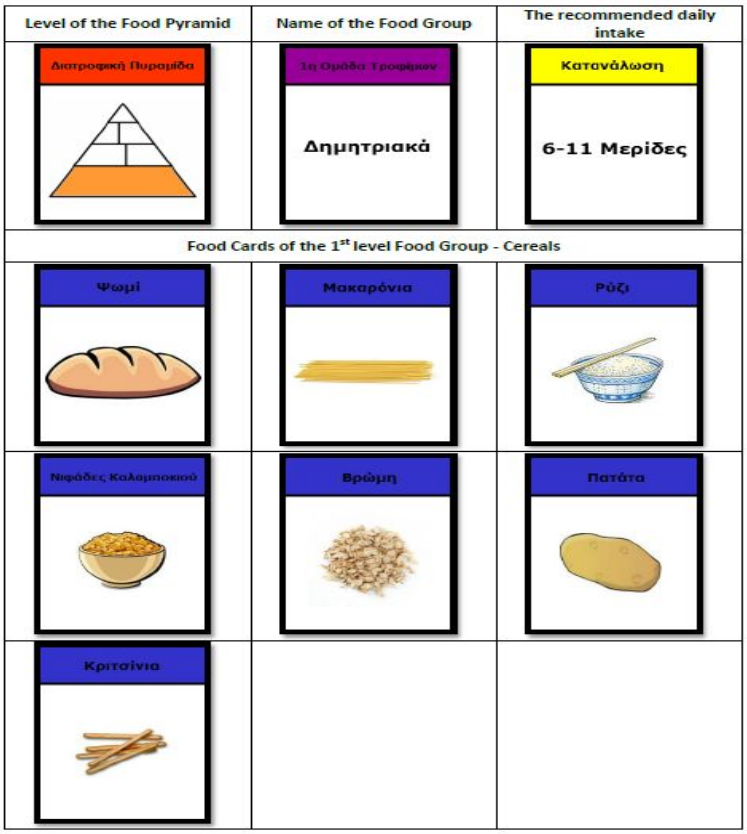

Fig. 1. An example of cards designed for the creation of a card game for the learning of the Food Pyramid

Step 3: Definition of appropriate card game-play learning activities: The objective of the suggested ECCG is to encourage players to collect all the appropriate cards of each level of the Food Pyramid; thus, classification has been used as an activity to facilitate students' learning of the concepts related to the aforementioned subject matter and overcome their difficulties. Card classification activities were designed in order to help students to understand the learning concepts in question by: (a) learning the nutritional value of basic foods, and their position in the Food Pyramid (b) thinking critically about foods in order to be encouraged to have a healthy lifestyle, and (c) to draw appropriate conclusions. Specifically, the 5 levels of the Food Pyramid could form 5 different "Food Groups" that could be involved in the card-game play. For each Food Group, a number of Food Cards (10 cards) have been designed. One of these cards illustrate the level of the Food Pyramid at hand (1^{st}, 2^{nd},…, 5^{th}), another card presents the group of foods included in the specific level of the said Food Pyramid, and another card illustrates the recommended daily intake of the foods belonging to the aforementioned specific food group. The rest seven cards illustrate different basic food representatives of each Food Group. An example of a set of cards needed for the realization of a valid grouping of the first Food Group (Cereals; that falls in the 1^{st} level of the Food Pyramid) is illustrated in the figures included in Figure 1.

Step 4: Definition of specific CG-play activities to help students overcome their difficulties: During this step, cards (named: "challenging cards") were designed to describe students' specific difficulties related to the learning concepts (20 cards; 4 for each concept in question). "Challenging cards" demonstrate incorrect textual statements about these concepts (analyzed in step 2). For example: "Cereals should not be consumed in daily basis". An example of this kind of cards is illustrated in the1st row of Figure 2.

Step 5: Definition of the kind of motivation that should be provided for students during CG-play: The card classification activities containing useful Food Guide Pyramid and Daily Guidelines for people is an interesting activity allowing students to evaluate their current nutritional habits and to create a plan for developing healthy habits to last a lifetime. Thus, four "joker cards" have been designed, reporting significant messages about food pyramid and good nutrition (e.g. why should people eat healthy or when a nutrition scheme is considered as balanced) which could participate in the creation of all the aforementioned food groups during the CG-play. "Joker cards" are presented randomly to the player. An example of this kind of card is illustrated in the 2nd row of Figure 2.

Fig. 2. An example of Challenging/motivation/scaffolding cards designed for an ECCG for the learning of the Food Pyramid

Step 6: Definition of the kind of scaffolding used during CG-play: A number of "Scaffolding Cards" have been designed (5 cards). These cards have textual and figurative parts and refer to foundational points of the concepts included in the subject matter model. Actually, those cards contain the combination of three basic cards that fall in each Food Group. "Scaffolding cards" appear on player's demand when he/she is unable to do the right matching. An example of this kind of card is illustrated in the 3rd row of Figure 2.

Step 7: Definition of the rules of CG-play: Two (2) big cards illustrating the rules of the game have been designed. The total number of cards included in this game is 81.

Summary and future research plans

This paper presents a game based approach of food safety and nutrition education. In fact, a "7-step design methodology" (Kordaki, 2015) has been adopted for the design of a 10-level educational computer card game (ECCG) in an attempt to help students learn basic topics about nutrition, health and food safety in a pleasurable environment. Ten essential topics about Food Safety and Nutrition for school children have been suggested by experts which will be handled by the said ECCG. According to the aforementioned methodology, the design of various types of cards has been proposed, namely: basic learning activity cards, motivation cards, challenging cards (to help students clarify their non-scientific conceptions), scaffolding cards, joker cards and information about the game cards. In addition, one example using the said "7-step methodology" for the design of an ECG was also demonstrated dealing with one of the 10 essential topics, namely: the Food Pyramid. On the whole, the ECG will consider all the aforementioned 10 essential topics; that is in our future plans. The implementation of the specific ECG in a digital mode is also in our future research agenda.

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