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Relationship between Designing Computer-based Educational Games, and Learning Motivation among Elementary Students

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Abstract

Background: Motivation is an important factor in learning. Educational games increase the learning motivation and understanding of students by creating a sense of joy, satisfaction and involvement. However, it is necessary to incorporate learning elements into the games, differently. In this study, the researcher tried to provide a model for designing educational games and determining its relationship with learning motivation.

Materials and Methods: Components of the model for designing educational games were first determined qualitatively. Then, the relationship between the educational games designed and students' learning motivation was determined. A self-made questionnaire, with elements of educational game designing along with another questionnaire was used to determine the learning motivation. The obtained data were analyzed using Pearson correlation coefficient and independent t-test.

***Results*:** The model, with 4 main components and 26 sub-components, was designed. That set of various elements, including: the rules, objectives, tools, results and feedbacks, accidents, challenges and interactions displayed in the context of the game, along with instructional design component such as analysis, design, development, utilization and evaluation were used. After implementation of the pattern and designing the "States of Matter" lesson in the science book for the third graders, the results showed that there is a significant correlation between the use of designed educational game and components of the students' learning motivation (r= 0.85 and P=0.01).

***Conclusion*:** According to this study given the relationship between the use of educational games and motivation to learn, it can be concluded that the educational games designed according to scientific principles could lead to the improved students' motivation and learning.

Key Words: Education, Learning, Instructional design, Motivation, Students.

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1- INTRODUCTION

The use of learning-based structures in teaching and designing learning environments based on the thinking and motivation will lead to the learners' meaningful and quality learning. Arrangement of proper elements in the learning environment can be a driving force to enhance the learning enthusiasm, spontaneity, self-discovery and inner control (1, 2). According to Cooper (1955) admits that the teaching skills include sub-skills such as communication, motivation, reinforcement, questioning, and classroom management (3). Learners' motivation to increase the level of participation and their learning activities are very important. Motivation is the force that creates, maintains and guides the behavior (4).

It affects learning and academic achievement. On the other hand, factors such as age, curriculum subjects, content organization procedure, learning environment, teachers, and interactions with learners can vary from person to person, as far as motivation to learn is concerned (5). Motivation is either internal (intrinsic), or external (extrinsic). Internal motivation is the intrinsic arguments and a tendency toward action, while external motivation is the extrinsic rewards that a person receives in exchange for an action (6). Seven factors are effective in improving internal motivation, including challenge, curiosity, control, fantasy, competition, participation, and recognition (7). *Challenge:* The factor of challenge requires the attention of the learner in the learning environment. *Curiosity*: Learner's interactions with the learning environment, stimulation of curiosity and following up the interesting things in the environment that lead to the increased motivation. *Control*: The factor of control is based on the fact that people like to have control over their fate. This requires a relationship of cause and effect, allowing the learner to select the learning theme, and the manner to learn it. Imagination: requires that learners use the images to motivate behavior, such as building a game that allows the learners imagine themselves, as users of information, in the real-world environments. *Competition*: This element allows learners to feel satisfaction through comparing themselves with others. *Participation*: Improves learners' satisfaction through helping others. *Recognition*: Upon recognition of the success of learners, a sense of satisfaction is achieved through helping others. Four important motivational theories include behavioral, socio-cognitive, humanistic, and humanism theory. Development of educational computer-based games is one of the manifestations of technological progress in the contemporary era. In recent decades, these games has attracted the attention of many educational leaders, so that they believe the computer games for the current digital generation could be the cause of increased motivation and understanding in students in the educational environments (7).

The factors associated with hesitation of educational experts in choosing educational games include questions such as how to design educational games that increase the participation and motivation of learners to learn in the teaching and learning process, how to promote the games based on the special needs, and how to design the games capable of solving the problems. In general, creation of the games and stimulants does not follow a specific production process. Rather, it needs to build and promote the mental models that are both new and complicated. Prensky (2007) introduced six digital features that a digital game must have, so that it can be considered a meaningful game (8). He suggests that a digital game should include rules, objectives and tools, results, and feedbacks, conflicts, and competitions, challenges and contrasts, interactions, and the spectacle (or the story). A proper

planning is required to be able to integrate these factors in educational topics and to apply them. The elements of general pattern of instructional designing that include analysis, designing, implementation and evaluation can be used to design an educational game with 6 features proposed by Prensky. In this research, while determining the elements of the model, its administrative framework is displayed. Then, the relationship between the designed game and motivation to learn is specified according to the self-determination theory (8). In a study in 2013, Aminifar et al. evaluated the effect of computer games on mathematical achievement and motivation of second grade middle school students (9). The results of this study showed that those teaching methods that are based on computer games, are effective in math achievement, motivation of progress and attitude toward math. Parseh et al. conducted a research in 2012 entitled "evaluation and comparison of the effects of educational computer games and traditional chemistry games on the motivation and academic achievement of first year high school male students", and compared it with conventional methods of teaching (10).

The results showed that there is no significant difference between those teaching methods that are based on educational computer games and traditional teaching methods in terms of students' learning enhancement. However, the use of educational games in teaching was effective in increasing students' motivation. Dehghanzadeh et al. conducted a study in 2015 and the aim of this study was to determine the relationship between gaming experience, digital self-efficacy and challenges of primary school teachers with the use of computer game-based learning (11). The results showed that there is a significant positive relationship between the gaming experience of the teachers and the use of these games. There is also a significant positive relationship between self-efficacy and the use of computer games, as well as a negative and significant relationship between computer games self-efficacy of teachers and teachers' inner challenges in applying these games. Moradi and Maleki conducted a study in 2015 and results showed that after training, a significant difference was observed in terms of academic motivation in the results of the experimental group compared with the results of the control (12). Velayati et al. conducted a study in 2013 and the results of this study showed that computer games teaching the concept of addition in mathematics enhance the learning and increase the motivation to the academic achievement of students with intellectual disability in math, but they do not increase the level of retention in them (13). Based on the report of studies conducted on teaching with games in the countries of Scotland, England, Wales, Netherlands, Italy and Turkey, released by the Futurelab website in 2013, it was concluded that the motivational dimension of digital games is the main reason of using them by the teachers in the classrooms (14). The results of the research conducted by Borden and Beyrd in 2006, has shown that educational games contribute to increase learning and learning motivation (15).

In 2010, Kebritchi et al. explained the result of their research as follows: students who played computer games in the classroom and laboratory are more motivated and have better academic performance compared to the control group (16). In this study, the researcher tried to provide a model for designing educational games and determining its relationship with learning motivation, so the hypothesis of the research was finding this relationship.

2- MATERIALS AND METHODS

2-1. Study design and population

The present study is an applied and exploratory combined qualitative and quantitative research. In the first stage using purposive sampling method, 50 instructors and subject matter experts were selected and underwent semi-structured interviews. In the second stage of the study, 100 elementary teachers of third grade primary schools were selected randomly.

2-2. Methods

The research questions (What are the components of designing a computer-based educational game? How the design pattern of a computer-based educational game looks like? Responded hypothesis (There is a relationship between computer-based educational game and learning motivation) to be tested. In the first stage of the study a qualitative and deductive content analysis and in the second stage correlation coefficient method were used.

2-3. Measuring tools: validity and reliability

In the first stage of the study an open ended structured questionnaire were used, and in the second stage of the study a self-made questionnaire with the elements of instructional design and game principles was used to determine the satisfaction of player with the game designed. The format of five-level Likert scales was used for this study. The questionnaire of students' Achievement motivation with, 49 questions was also used to collect data, based on the observation of teachers from the achievement of their students. In this study, a short form of Inventory of School Motivation (ISM, McInerney and Sinclair) (17), developed by Bohrani (1993) in Shiraz, was used (18). These questions are about the goal setting, competitiveness, tendency to work and tasks, tendency to progression, social dependence, social cooperation, fame-seeking, material rewards questions are about power-seeking, self-esteem, and self-reliance. In general, the results of the questionnaire reliability test showed that the calculated Cronbach's alpha coefficient is equal to 0.84. Moreover, in all stages of the research, compliance with moral obligations including informed consent, confidentiality, etc. were taken into account.

2-4. Intervention

At the first stage, the interviews continued until data saturation. This means that no new theme was added to the data by the interviews. Finally, components of educational computer games became clear with observations, literature review, documentation and implementation of interviews. The units of analysis in this study were word, sentence and page. The data analysis process, as open and axial coding, was conducted according to the process proposed by Graneheim and Lundman (2004) which includes (19):

1. Implementation of interviews immediately after each interview,
2. Reading the transcript for general meaning and understanding,
3. Determination of meaning units and primary codes,
4. Classification of similar primary codes into more comprehensive classes,
5. Determination of the content embedded in data. Finally, the researcher determined categories and subcategories by analyzing the codes and removing duplicate codes.

The final analysis was performed in the form of a clear conceptual framework which is explained below. A questionnaire was designed based on this conceptual model. Finally, the Delphi method was used for approval or disapproval of data with three sweeps for experts. Its reliability was evaluated by the Cronbach's

alpha test using SPSS with a score of 0.80. The second stage of study was conducted using correlational quantitative method. A self-made questionnaire with educational game design and another questionnaire to determine the learning motivation were used. Reliability and validity of questionnaires were determined. The resulted data were analyzed using Pearson correlation coefficient and independent t-test.

2-5. Ethical consideration

The ethical considerations necessary to satisfy the respondents were observed and they were ensured that their views will be kept confidential. Further, it was announced that inclusion of these participants in this study was absolutely voluntary, with the anonymity of the questionnaire being emphasized to ensure them that their information would be collected and kept confidentially.

2-6. Inclusion and exclusion criteria

Inclusion criteria included having a written consent on behalf of the parents in order to implement the game in the classroom. Exclusion criteria included unwillingness to participate in the study and the absence in training sessions or transfer a student from school.

2-7. Data Analyses

In the first stage of the research for data analysis process, as open and axial coding, was conducted according to the process proposed by Graneheim and Lundman (2004). In the second stage of the research the resulted data were analyzed using Pearson correlation coefficient using SPSS 21.0 software.

3- RESULTS

To answer the first and second research questions("What are the components of a computer-based educational games?" and "How is the conceptual model of computer-based educational design?"), fifty instructors with the following characteristics were interviewed: 30% female and 70% male instructors, 20 percent of them had postdocs, 45 percent had PhD and 35 percent had master's degree. Ninety percent of them were faculty members, 10 percent were non-academic staff, 65 percent were assistant professors, 20 percent were associate professors and 5 percent were instructors. The open encoding stage: 160 concepts (basic code) were obtained from interviews, and 296 concepts (basic code) were obtained from theoretical texts and literature. The stage of axial coding: in this stage, the concepts (common and similar codes in terms of meaning) were classified within the framework of four main components and 26 sub-components.

3-1. What are the components of a computer-based educational games?

In answering the first question of the research 15 main components were determined which are as follows: Goal setting, Competitiveness, Tendency to work, Tendency to progress and achievement, Social dependency, Social assistance, Fame seeking, Expressions of interest, Curiosity, Strengthening success, Success, The incidence of motivational behavior, Educational game.

3-2. How is the conceptual model of computer-based educational design?

Based on **Figure.1**, the conceptual model of computer-based educational game design is as follows:

3-2-1. First stage: Analysis

Analysis, which includes the following components: logical and theoretical structures, the idea, forming a team and defining the role of its members, determining the start and end points, current and desired situation, determining the players, determining subject and content, technical, managerial, protective and supportive aspects, constraints.

3-2-1-1. Logical and theoretical structures

Knowledge of scientific and theoretical foundations of educational games are prioritized to any other activity. People who want to work in this field should obtain all necessary information in the field of scientific and technical issues of educational computer games production and acquire necessary skills to do it.

3-2-1-2. The idea

A new and practical idea is usually needed in order to design new educational games; otherwise, the previously designed and produced ones can be used.

3-2-1-3. Forming a team and defining the role of its members

For the design and production of educational computer games, it is needed to form a team and then determine the role of each team member in completing the project. A team usually may include: Software expert, game designer, educational technologist, and an expert on the training subject.

3-2-1-4. Determining the start and end points

The game designers have no standard plan for the starting point of the game development. Although they take into account the audiences in initial steps like game idea, gameplay, and technical environment of the game, adopting any of these steps as a starting point may cause different results. The project of a game often starts with an idea. The spark of an idea, its development and revealing begin eventually with the characters of the game. The ending of the game is also important, and the game should end in a way that seems rational and attractive to the player.

3-2-1-5. Current and desired situation

The team must determine the current and desired situation to identify the type of changes and needs.

3-2-1-6. Determining the players

Always in game design, players are responsible for most pivotal roles. All members of a game design team should always have this matter in mind in order to design a game that is so attractive to players that makes them immersed in the game. This can be achieved only by focusing on the game, such as when an avid reader is immersed in a book and experiences the love and despair of the author from deep heart, and is so focused on the book that is detached from the surrounding environment. The reader is merely placed in a fluid flow.

When a computer programmer works uninterruptedly for one week in a room and forgets to eat or sleep, the programmer is in a fluid flow. This fluid flow is a grueling yet exhilarating experience which is outside the community that is both overwhelming and realist. Game designers are interested in designing the games that are satisfactory for players. Therefore, they should always bear in mind the wishes of the players, but at the same time add educational (instructional) elements to the games and stimulants so that both the purpose of learning and the charm of the game will be maintained.

3-2-1-7. Determining subject and content

Content and subjects are organized and determined as needed.

3-2-1-8. Technical, managerial, protective and supportive aspects

The type of programming, the type of game designing software, the type of its platform and whether it is web-based or not, user interface, its distribution to players, and which system specifications to support are of technical points of the work. Management of the program, protection of design and production of educational games during the analysis, design, production and evaluation stages should be

identified. Also, how to fund the work should be specified and budgeted according to the viewpoints of the group members.

3-2-1-9. Constraints

Financial, locational, equipment, manpower, logistic, technical and managerial constraints should be specified. Social and cultural resistance must also be considered.

3-2-2. Second stage: Design

Designing which includes the following components:

Basics of the game, Instructional design principles, Principles of art, color, light and texture, Principles of cognitive psychology, Cultural and ethical principles.

3-2-2-1. Basics of the game

3-2-2-1-1. Rules of the game

The rules, limitations, and restrictions of the games which are required to be observed by the players, so that the player can achieve the goals using certain behaviors.

3-2-2-1-2. Objectives of the games

The easiest objectives of the game are the actions taken by the player to win, which depend on the speed of the game, earning of more points, and the fact that the game should be over with more money. Although most of the game objectives are discussed apart from the rules of the game, they are determined implicitly by the law, since the players' performance should be within the framework of a set of activities prescribed by the law. The rules, whether implicit or explicit, have powerful impact on the players, since the players are limited by a collection of activities, which are in fact prescribed rules. Therefore, whether implicit or explicit, rules have a powerful influence on the players.

3-2-2-1-3. Results and feedback

The aim of players is usually winning the game. The result of the game is the status of player or players at the time of completion of the game. If the game is stopped before reaching the final stage, there is no result and it has not been completed. In single-player games, the player will either win or lose. In two-player games, the result may be in favor of the first player, then the second player is the loser and vice versa. The result may also be a draw. Sometimes the results are very complicated.

A generally accepted standard for describing learning classification is Bloom's taxonomy of learning domain (3): 1- Knowledge, 2- Comprehension, 3- Application, 4- Analysis, and 5- Synthesis. Adding education, with any nature and level of learning, will affect the strategy of game, and the use of one or any combination of these six areas of learning will be effective in various aspects of the game plan. Feedback is a batch of data that changes the results. When a player performs an action, the game system reacts to it in a specific way, which makes the players to be able to do a process or decide to click on a page that gives clues to the players, to continue playing.

In digital games, feedback may be a color, a sound, a change in the form of the components of the game, the speed, the direction, or a discovery. In the games, the score is the increase the players' options, or an abrupt end with the appearance of the two-word phrase "Game Over". The aim of feedback in the game systems is to provide the constant news to the player about how the game is going. As a result, the player can adopt the next appropriate techniques in order to successfully achieve the goals of the game and to win.

3-2-2-1-4. Conflict and challenge

Conflict or competition, and challenge or opposition, are insoluble concepts of the games. Open games do not need conflict or

competition. A fun game is not challenging. When someone turns a fun game, and continues to play in order to see how it keeps its balance, this does not imply any competition or dispute. However, if a second player is added to the process of winning the game, reaching the top level of the game would take longer than what it takes when the first player was playing. Even if the second player can reach to the level of the first player, this stage will be longer yet.

Nature of the activity of a game, which is to increase the sense of competition between the players, will change the nature of activities. Rules of the game shall be predicted to run this competition and conflict. The games should be simple and easy to learn, but acquisition of skills in playing games must be difficult. Games are required to maintain a certain level of challenge. It is necessary to adjust the difficulty level of the games during playing; but it should not be so difficult that becomes onerous for the player, and refrains from continuing.

3-2-2-1-5. Interaction

All games are interactive, but the nature of interactions varies widely. Consider chess and tennis. Systems of both games provide a set of information to the player to adjust tactics and strategies. Digital modern educational games have particular interactive capabilities. Four of the interactive features of computer games that designers need to be aware of them include: Being interactive which is immediate, but not limited to, is the ability to keep and manipulate the data, the existence of complex automatic systems and the use of interactive communication. Digital games begin by entering a player to the game. Entering in the game is usually conducted by clicking on a mouse and a small set of buttons embedded on the computer keyboard; or on the playing device. Because of the ability of computers to give constant or action feedback, their product has a uniform and integrated nature; but it is not limited to the display and the sound. Computers' capacity to keep and build information, allows digital games to choose large amounts of data and place them in appropriate places throughout the game playing and display them. They even teach the players the rules during the game.

3-2-2-1-6. The course of the story

Is the story of the games, as the course of a produced game that represents a theme or an objective; characters and movement of the scenes make the gaming world. Naturally, a ship or the football field must be in interaction with human, but as a game, a system is self-contained which includes all sectors and interactions that give life to them as an object.

3-2-2-2. Instructional design principles

Knowing the instructional designing process and the manner of applying this process are of requirements to design educational games. Considering the instructional approaches such as behaviorism, cognitivism, constructivism, and connectivism a model can be selected based on them. In this paper, the general pattern of educational (instructional) design, including analysis, designing, implementation and production, and evaluation was used.

3-2-2-3. Aesthetics (Principles of art, color, light and texture)

This part is related to the appearance and the art - video aspect of the games. It identifies what media, with what quality (such as exposure to scenes, images, animations, etc.) should be used.

3-2-2-4. Principles of cognitive psychology

It is necessary to pay attention to recognition and memory capacity of

individuals; and observe the necessary points for memory consolidation of issues

3-2-2-5. Cultural and ethical principles

Social and cultural aspects of the game must be taken into consideration; so that they would be consistent with the society-based values.

3-2-3. Third stage: Implementation and Production

Production and implementation which includes the following components: Pre-production, Initial implementation, and removal of deficiencies, Completion of documents, appropriate packaging along with instructions, Advertising, and Distribution.

3-2-3-1. Pre-production

The initial production of a product shall be assessed.

3-2-3-2. Initial implementation and removal of deficiencies

Pre-production version of a game must be provided to a number of target groups or players to be played by them and then its shortcomings to be identified.

3-2-3-3. Completion of documents

Contracts, minutes of meetings and any other important documents are concluded and completed in the early implementation stages.

3-2-3-4. Appropriate packaging along with instructions

The packing of the game is taken into consideration in terms of the beauty of its cover and packaging design, intellectual property, how people can access to it, and the package price. Instructions for using the Games must be transparent and clear.

3-2-3-5. Advertising

Virtual media and Internet could be used to promote the advertising process.

3-2-3-6. Distribution

A cohesive and appropriate program should be planned for the ease of access to the product.

3-2-4. Fourth step: Evaluation

Evaluation which includes the following components: Monitoring, Control, Evaluation and revision, Documentation.

3-2-4-1. Monitoring

The team members can choose a director for themselves. This director can monitor the stages of analysis, designing, implementation, and production based on a proper planning.

3-2-4-2. Control

The director can plan to control and monitor every stage of the work in order to enhance their quality.

3-2-4-3. Evaluation and revision

Eventually, after the distribution of the game, the main players shall be surveyed; because it is effective in the revision of the work.

3-2-4-4. Documentation

Documentation of all stages of analysis, design, implementation, production and evaluation need to be reported and documented; because it can be used in promoting and developing the games. In the second stage of the research the data required to test the research hypothesis "there is a relationship between designing computer-based educational games and learning motivation among elementary students" indicators of descriptive statistics of the scores obtained from tests of academic achievement motivation, and satisfaction of players with computer-based educational games are as follows: **Table.1** shows the results of the main research hypothesis testing showed that there is a significant relationship between academic achievement motivation and satisfaction of the educational games, since the relationship, with a correlation

coefficient of 0.85, was significant at an alpha level of 0.01. Furthermore, the findings of this table showed that among the elements, reinforcement of the success and achievement of success have the highest correlation with educational game (r=0.83, p=0.01). The elements of power-seeking and fame-seeking are also inversely related to satisfaction of educational games. (*Please see the table in the end of paper)*

4- DISCUSSION

This study was conducted to provide a model for the design of computer-based educational games. According to **Figure.1**, the qualitative objective of the research was achieved. This model has 4 main components and 26 sub-components which a computer-based educational game designer can use. The results of the present study are consistent with the results of the study conducted by Prensky (8). (*Please see the figure in the end of paper*).

Also, as far as the use of educational games and its impact on students' motivation are concerned, the results of the present study is consistent with the result of some other studies (9-16) and showed that the use of educational games is effective on the students' motivation to learn. It seems that the attention researchers to the components of instructional design that a game was designed and implemented on the basis of them, made the students' motivation increased. The results of the research indicated that there is a relationship between the satisfaction of students in using educational games and motivation to learn. Furthermore, subcomponents of analysis in designing educational games are very important so that they affect the content in achieving educational goals. Moreover, in design stage in addition to the principles of game and principles of instructional design, principles of culture and ethics should be considered carefully. Finally, the production of educational games tailored to an appropriate model in the schools and even universities is recommended.

4-1. Limitation of study

Some of the students who participated in the study may have had a good experience in playing computer games but some others may not have such experience and it may have affected the motivation of the students.

5- CONCLUSIONS

With regard to the obtained results of the present study, it is better in designing educational games the components of instructional design to be considered so that in planning strategies for an active learning the students' motivation is enhanced. In answering the first question of the research 15 main components were determined and in answering the second question a conceptual model for learning environment of the games were designed which has 4 main components and 26 subcomponents as shown in figure.1.Pearson test based on the research results showed that there is a positive relationship between satisfaction of the computer games and the proposed design with the motivation of learning.

6- CONFLICT OF INTEREST: None.

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Table-1: The results of correlation coefficient of academic achievement motivation and game satisfaction components

Variables	Goal setting	Competitiveness	Tendency to work and duty	Tendency to progress and achievement	Social dependency	Social assistance	Fameseeking	Expressions of interest	Curiosity	Strengtheningsuccess	Success	The incidence of motivational behavior	Designed educational games
Goal setting	1												
Competitiveness	r=.51 p= .001	1											
Tendency to work and duty	r=.56 p= .002	r=.46 p= .005	1										
Tendency to progress and achievement	r=.68 p= .001	r=.84 p= .003	r=.69 p= .002	1									
Social dependency	r=.45 p= .002	r=.53 p= .004	r=.79 p= .007	r=.63 p= .002	1								
Social assistance	r=.56 p= .003	r=.62 p= .001	r=.63 p= .005	r=.83 p= .002	r =.45 p= .001	1							
Fameseeking	r=.36 p= .005	r=.82 p= .004	r=.53 p= .001	r=.73 p= .003	r=.35 p= .008	r=.16 p= .006	1						
Expressions of interest	r=.26 p= .001	r=.68 p= .005	r=.53 p= .003	r=.63 p= .007	r=.46 p= .004	r=.56 p= .004	r=.62 p= .002	1					
Curiosity	r=.62 p= .005	r=.81 p= .003	r=.69 p= .002	r=.72 p= .002	r=.36 p= .004	r=.26 p= .003	r=.66 p= .001	r=.43 p= .002	1				
Strengtheningsuccess	r=.72 p= .003	r=.62 p= .002	r=.82 p= .001	r=.73 p= .003	r=.66 p= .005	r=.46 p= .007	r=-.13 p= .006	r=.16 p= .002	r=.17 p= .001	1			
Success	r=.83 p= .007	r=.73 p= .003	r=.86 p= .009	r=.83 p= .005	r=.76 p= .003	r=.76 p= .002	r=-.17 p= .002	r=.13 p= .001	r=.12 p= .002	r=.83 p= .003	1		
The incidence of motivational behavior	r=.68 p= .001	r=.65 p= .002	r=.72 p= .003	r=.76 p= .005	r=.52 p= .007	r=.46 p= .006	r=.51 p= .005	r=.28 p= .007	r=.45 p= .002	r=.83 p= .001	r=0.78 p= .002	1	
Designed educational games	r=.66 p= .002	r=.57 p= .001	r=.75 p= .001	r=.74 p= .002	r=.76 p= .004	r=.68 p= .003	r=-.18 p= .002	r=.53 p= .004	r=.16 p= .008	r=.83 p= .004	r=.83 p= .001	r=.85 p=.001	1

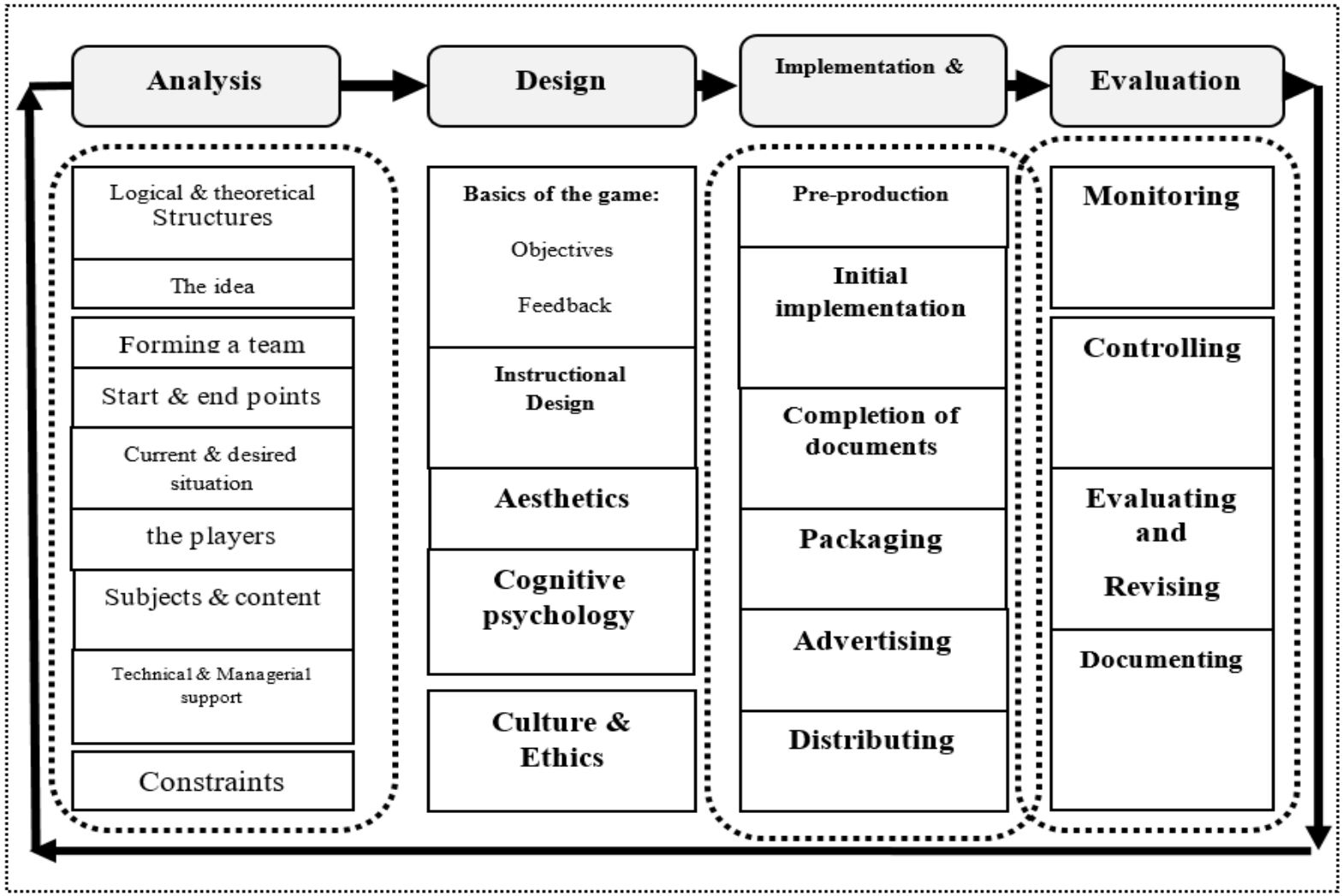

Fig.1: The conceptual model of computer-based educational game design.