Relationship between learning styles and genres of games

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Abstract

Computer based games for learning, like any other computer games, have different genres. They can be categorized as action, puzzle, strategy, and so on. On the other hand, different learners have different characteristics, such as learning styles, personality and cognitive traits. Because of that, they receive and process information differently. Recommending computer based games for learning, based on which genre suits a learner’s characteristics best, could enhance learners’ motivation and lead to a better learning experience. In this context, this study investigates the relationship between one of the learner characteristics, namely learning styles, and genres of games. In particular, this study proposes four relationships between two dimensions of Felder-Silverman learning style and four genres of computer games. In order to validate the proposed relationships, experimentation was conducted in a tertiary school in Tunisia (ISIG Kairouan) in which 74 participants answered two questionnaires about preferences on genres of games and learning styles. Data gathered from the instruments was analyzed through the use of the statistical test Chi-square. Results of the experimentation validated two relationships among four and rejected two. The confirmed relationships can be exploited by teachers and E-Learning recommendation systems in order to provide more personalized recommendations to learners.

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1. Introduction

The domain of computer based games for learning is relatively new but is a rapidly growing phenomenon. A number of factors have led to this interest. First is the availability of easy-to-use tools to create computer based games for learning. Second is the belief that games could teach 21st century skills such as collaboration, innovation and production (Gee & Shaffer, 2010; McClarty et al., 2012). Third is the desire to move from traditional educational methods to modern educational methods that include contemporary software programs, distance-learning, virtual learning environment and computer based games for learning. In addition, a lot of research in the literature has demonstrated that computer based games for learning have many advantages for the learners (Rosina, Rasimah, Mohd, Hasiah, & Azizah, 2011; Sasha, Michael, Tyler, Robert, & Hakan, 2005). In fact, game and, particularly, computer based games for learning can attract the attention of...
learners, and increase their motivation and their engagement that can lead to enjoyable and effective learning experiences (Erhel & Jamet, 2013; Eseryel, Law, Ifenthaler, Ge, & Miller, 2014).

However, the use of computer based games for learning also has potential to affect the learning experience negatively if the characteristics of individual learners are not taken into account. In fact, different learners receive and process information differently. On the other hand, computer based games for learning have different genres similar to any other computer games, and different genres may have different impact on learning experience of the learners with different characteristics. Computer games genres can be categorized as action, puzzle, adventure, simulation, casual, strategy, and so on. For example, some learners can learn better through action and adventure games, while others may learn better through games based on deep thinking, such as strategy games. So, different genres of games may suit to different learner characteristics, such as learning styles, personality and cognitive traits. This study looks at one of the learner characteristics, namely learning styles, in the context of computer based games for learning. Selecting the appropriate game genres that suit individual learner’s learning styles and recommending these games to learners could enhance their motivation, resulting in better chances for success in the learning process.

In order to explore the relationship between genres of games and learning styles, Section 2 examines the literature related to learning styles and genres of games. Specifically, it first looks at various learning style models. Then, various genres of typical computer games are analyzed, since computer based games for learning have similar characteristics and genres as any other types of computer games. After that, Section 3 presents proposed relationships between the learning styles and genres of games. The proposed relationships are based on the alignment between the characteristics of various genres of games and the characteristics of various learning styles. Section 4 describes experimentations conducted to validate the proposed relationships. In particular, learners’ preferences for games genres and their learning styles are analyzed. Finally, the paper concludes by discussing the findings and providing the future research directions.

2. Learning styles and genres of games

Before analyzing the relationships between the learning styles and genres of games, both concepts are introduced in order to provide background information for current investigations.

2.1. Learning styles

Learning style is one of the individual differences that play an important but controversial role in the learning process. Although a lot of research has been conducted, some important questions are still open. According to the report published by Coffield, Moseley, Hall, and Ecclestone (2004), Popescu (2009, 2010), Brandt (1990), Graf and Liu (2010), the controversial aspects surrounding learning styles are mainly related to the proliferation of definitions and concepts which sometimes overlap. Moreover, there is a very large number of learning style models, many different views and there is no unanimously accepted one. In addition, there is no mapping between the different models and there is no agreed taxonomy. Some of the controversial aspects are related to the reliability and validity of instruments for identifying learning styles. In fact, some of the instruments used to measure learning styles could not demonstrate internal consistency, test-retest reliability or construct and predictive validity. Another controversial issue is related to the feasibility and effectiveness of incorporating learning styles in education, and the way learning styles should be used in education. On the other hand, while pointing out the limitations, many other researchers acknowledge also the benefits of using learning styles and argue that the consideration of learning styles is an important factor in education (e.g. Coffield et al., 2004; Felder & Silverman, 1988; Graf & Liu, 2010).

2.1.1. Definition of learning styles

“The term ‘learning styles’ has no one definition. A lot of definitions of learning style have been written and several models of learning styles have been proposed yet. Felder and Silverman (1988) defined learning style as an individual’s preferred way of acquiring, retaining and processing information. This view is consistent with James and Gardner (1995) who outlined that learning style is the way in which learners perceive, process, store and recall attempts of learning. Reinert (1976) described learning style as “the way in which that person is programmed to learn most effectively i.e., to receive, understand, remember, and be able to use new information” (p. 161). Learning style is also defined as a person’s individually preferred method for best gathering data, processing it, and putting it to later use in terms of concrete experience, reflective observation, abstract conceptualization and active experimentation (Kolb, 1976), Gregorc (1979) defined learning style as “distinctive behaviours which serve as indicators of how a person learns from and adapts to his environment. It also gives clues as to how a person’s mind operates” (p. 234). Dunn, DeBello, Brennan, Krimsy, and Murrain (1981) indicated that learning styles include variables such as individual responses to sound, light, temperature, design, motivation, responsibility, need for structure, perception, need of intake, energy levels and mobility needs.

The differences among the views on how the styles should be defined produced a number of learning styles models and theories. Coffield et al. (2004) listed 71 different learning styles in their review on Learning style and pedagogy in post-16 learning. 60 of the styles have their own measurement tool. Coffield’s review examined 13 learning style models where each model was examined for evidence, provided by independent researchers, that the instrument could demonstrate both
Among this number of proposed learning styles, there are only a few that have been used in computer assisted learning applications and their reliability and validity have been tested (Soflano, Connolly, & Hainey, 2015a; Soflano, Connolly, & Hainey, 2015b). The theories are Kolb’s learning style; Dunn and Dunn’s VAK model; the Big-5 model; Honey and Mumford and the Felder-Silverman’s learning style (Soflano et al., 2015a). In particular, the Felder-Silverman Learning Style Model (FSLSM) has received considerable attention in the computer assisted learning applications, compared to other learning style theories (Huang, Lin, & Huang, 2012; Soflano et al., 2015a; Ozpolat & Akar, 2009). The Felder-Silverman learning style model has been widely used in technology-enhanced learning systems (Hwang, Chiu, & Chen, 2015; Hwang, Sung, Hung, & Huang, 2013; Latham, Crockett, & McLean, 2014; Lin, Hung, Chang, & Hung, 2014; Ozpolat & Akar, 2009) since the four dimensions are highly related to the design of computer-based system interfaces or the way of presenting digital learning materials (Hwang et al., 2015). Compared to other learning style models, the Felder-Silverman model represents elements from most models. In fact, Felder and Silverman have synthesized findings from many studies to formulate their own learning style model. This indicates the generalisability of the model (Soflano et al., 2015a). Regarding the assessment of this learning style model, a questionnaire, Index of Learning Style (Felder & Soloman, 1997), is developed by Richard Felder and Barbara Soloman to assess preferences on the four dimensions of the FSLSM. This questionnaire is available free on the internet and its reliability and validity have been tested (Felder & Spurlin, 2005; Wang, Mendori, & Xiong, 2014). For these reasons, and view that the dimensions of the Felder-Silverman Learning Style Model could be considered as the most appropriately aligned with a set of game genres, the Felder-Silverman Learning Style Model is used in this study.

2.1.2. Description of the Felder-Silverman learning style model

The Felder Silverman learning style model was created by Richard Felder and Linda Silverman in 1988 (Felder & Silverman, 1988). This model consists of four dimensions: active/reflective, sequential/global, sensory/intuitive and visual/verbal, as explained below.

- **Active/Reflective**: This dimension distinguishes between an active and a reflective way of processing information (Felder & Silverman, 1988; Graf, Lin, & Kinshuk, 2008). Active learners like to try things out and they learn best by working actively with the learning material. They tend to be experimentalists and always try to converge all activities happening around them. In contrast, reflective learners prefer to think about things on their own and reflect on the material. They prefer to take a step back to reflect on and examine situations from different points of view and tend to be theoreticians (Felder & Silverman, 1988; Graf, Viola, Leo, & Kinshuk, 2007; Graf et al., 2008; Hsieh, Jang, Huang, & Chen, 2011).

- **Sequential/Global**: In this dimension, learners are characterized according to their understanding (Felder & Silverman, 1988; Graf et al., 2008). Learners who have sequential learning style learn better step by step, successively chained and small incremental steps. They learn best when content is presented in a steady progression of complexity and difficulty. Sequential learners prefer to organize information in a linear, orderly fashion and they tend to follow logical stepwise paths in finding solutions. In contrast, learners who have global learning style understand things better as a whole. They use a holistic thinking process and learn in large leaps. Because the whole picture is important for them, they tend to be more interested in overviews and in a broad knowledge. Global learners are often able to solve complex problems, although they may not know how they arrived at the solution (Felder & Silverman, 1988; Graf et al., 2007).

- **Sensing/Intuitive**: Sensing learners like learning facts and solving problems with known methods and standard approaches, and they dislike surprises or unexpected effects. They are patient with details but do not like complications. Conversely, intuitive learners prefer discovering possibilities and relationships. They tend to be more innovative and creative than sensing learners. They like innovation and dislike repetition. In addition, they are bored by details and welcome complexities (Felder & Silverman, 1988; Graf et al., 2007, 2008).

- **Visual/Verbal**: Visual learners prefer visual representations of presented material such as pictures, diagrams and flow charts. They remember best what they see. However, if something is simply said to them they will probably forget it. On the other hand, verbal learners remember much of what they hear and more of what they hear and then say. They prefer textual representations, regardless of whether they are written or spoken. They learn effectively by explaining things to others (Felder & Silverman, 1988; Graf et al., 2007, 2008).

Learners have individual preferences for each dimension that can be strong, moderate, or balanced. FSLSM expresses these preferences on a scale from +11 to –11 per dimension. For example, in sequential/global dimension, the value +11 means that a learner has a strong preference for sequential learning style, whereas the value –11 states that a learner has a strong preference for global learning style.

The next sub-section will look at various genres of games, before analyzing their relationships with different learning styles.

2.2. Genres of games

In this study, the concept of game genre is defined as a method of categorization used to better understand a collection of video games. Along the history of video games, the concept of game genre suffers from a lack of innovation and it has been...
slowly evolving (Clearwater, 2011). Furthermore, there is no widely accepted standard on categorizing video games. Moreover, all the existing taxonomies share weaknesses in describing many games available today. Some games do not fit into any of the existing categories, while other games fit in many categories.

The classification of video games depends on several variables. According to Carr, David, Andrew, and Gareth (2006), a game can simultaneously be classified according to the platform on which it is played (PC, mobile phone, Xbox), the style of play it affords (multiplayer, networked, or single user, for instance), the manner in which it positions the player in relation to the game world (first person, third person, ‘god’), the kind of rules and goals that make up its gameplay (racing game, action adventure), or its representational aspects (science-fiction, high fantasy, urban realism). Wolf’s (2001) provides alternative taxonomy of genre which concentrates on the types of interactions that are available in the game. In his book, “The medium of the video game’, Wolf see that interactivity is an essential part of every game’s structure and a more appropriate way of examining and defining video game genres (Wolf, 2001).


In particular, games based on puzzle and god games, in addition to casual and simulation are used as a basis for considering the genres of games that might be the most suitable and adaptable to the dimensions of FLSLM. The selection of these genres is based on similarity between their characteristics with the characteristics of the dimensions of FLSLM. Selected genres of games are described as follows:

- Games based on puzzle: Puzzles are presented on their own without story or content action. In this genre, primary conflict is not between the player-character and other characters, but rather the figuring out of a solution. Puzzle games assume that players benefit from each achieved step in order to do the current step.
- God games: God Games have no preset win conditions. Players are given a variety of tools to work with and a whole global vision of the virtual environment. After that, the players choose their own path.
- Casual games: Casual games are simple, easy to learn and not difficult to master. They are designed especially for “new gamers”. Players are not obliged to have some special skills to play this genre of games.
- Games based on simulation: This genre of games focuses on the players’ imagination to do what cannot be done in real life, such as management of communities and imaginative projects.

This section presented definitions of learning styles and described different dimensions of Felder Silverman learning style model. In addition, this section described different genres of games. The next section moves on to propose relationships between learning styles and genres of games.

3. Relationship between learning styles and genres of games

Computer based games for learning, like any other computer games, have different genres that can be suitable for different learning styles. Selecting the appropriate learning game genre to suit a particular learning style has potential to increase learners’ learning success.

One of the few studies investigating the relationship between learning styles and genres of games was conducted by Rapeepisarn, Wong, Fung, and Khine (2008). The study provided a mapping of Honey & Mumford model of learning styles with players’ behaviors in the game, their computer use, learning activity and possible preferred game genres. However, the study stayed at a theoretical level and no experiment was conducted to validate the proposed relationships.

As another example, Khenissi, Essalmi, and Jemni (2013) investigated the relationship between the active/reflective dimensions of FLSLM and games based on action. The study assumed that learners with active learning style are strongly related to their preference on action games. In order to check the proposed relationship, experimentation was conducted with participants. At the end of the experimentation, participants’ preferences of games and their learning styles were analyzed. The study showed that results of the experimentation were positive.

Since this experimentation was successful in showing a relationship between a genre of games and one dimension of learning styles, it was decided to conduct a broader survey to investigate more genres and more learning styles. Specifically, the current investigation proposes relationships between two additional dimensions of FLSLM and various genres of learning games. The two dimensions of FLSLM considered by this study are: sequential/global and sensing/intuitive. The proposed relationships are based on similarity between the characteristics of various genres of the games and the characteristics of Felder-Silverman learning styles.
Firstly, this study proposes a relationship between sequential dimension of learning styles and the games based on puzzle. Sequential learners prefer material presented in a logically ordered progression (Felder & Silverman, 1988; Felder & Soloman, 2014). They follow linear reasoning processes when solving problems. In addition, they learn better step by step, successively chained and in small incremental steps. Moreover, they follow logical stepwise paths in finding solutions. Puzzle games assume that players benefit from each achieved step in order to do the current step (Adams & Rollings, 2006; Wolf, 2001). Particularly, puzzle games usually involve solving a puzzle in order to advance. Furthermore, this genre of games typically offers a series of related stages that are usually presented to the player sequentially. Thus, the player has to benefit from the previous stage in order to solve the next one. These characteristics fit the needs of sequential learners.

As a second relationship, the relationship between the global dimension of learning styles and the god games genre is considered. Global learners prefer to learn through big leaps and they enjoy the most when permitted to choose their own path (Felder & Silverman, 1988; Felder & Soloman, 2014). They may have difficulty working with material that they have only a partial or superficial understanding of. They need the big picture, an overview first and after that they are able to concentrate on details. God games genre seems to be the most appropriate to this dimension. In fact, the god games cast the players in the position of controlling the game on a large scale (Bates & LaMothe, 2001). In this genre of games, players are given a variety of tools to work with and a whole global vision of the virtual environment. After that, the players choose their own path. These features are consistent with the skills of global learners.

With regard to the sensing/intuitive dimensions of learning styles, this study considers that the sensing dimension is related to the casual games. Sensing learners like solving problems with known methods with no surprises or unexpected effects (Felder & Silverman, 1988; Felder & Soloman, 2014). Besides, they do not like complications. On the other hand, casual games provide a well-oriented scenario with the absence of conflict points (Bates & LaMothe, 2001; Chiapello, 2013; Kultima, 2009). Moreover, this genre of games is known for its simplicity and being far from being complicated. In fact, it is characterized by simplified design with minimal elements and user interfaces. In addition, this genre of games generally avoids complex topics. For these reasons, casual games meet the needs of sensing learners.

Finally, this study considers that intuitive dimension of learning styles can be related to the games based on simulation, due to the fact that intuitive learners are innovative and hate repetitive work, they also assimilate new concepts easily, and they are less concerned with order and sequence. They like discovering possibilities and relationships; they like innovation, and they enjoy designing new methods to solve problems (Felder & Silverman, 1988; Felder & Soloman, 2014). Simulation games focus on players’ imagination to do what cannot be done in real life. Simulation game can be considered as a case study of a particular reality. It consists of an environment that allows players to carry out different strategies (Gredler, 2004). For these reasons, the characteristics of the games based on simulation fit the needs of intuitive learners. The proposed relationship between learning styles and genres of games is shown in Table 1.

<table>
<thead>
<tr>
<th>Felder-Silverman learning style dimensions considered in this study</th>
<th>Preferred game genres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Global Sensing Intuitive</td>
<td>Games based on puzzle</td>
</tr>
<tr>
<td></td>
<td>God games</td>
</tr>
<tr>
<td></td>
<td>Casual games</td>
</tr>
<tr>
<td></td>
<td>Games based on simulation</td>
</tr>
</tbody>
</table>

In order to check the proposed relationships, this study poses four hypotheses, as follows:

**Hypothesis 1.** Learners with sequential learning style are related to their preference on puzzle games.

**Hypothesis 2.** Learners with global learning style are related to their preference on god games.

**Hypothesis 3.** Learners with sensing learning style are related to their preference on casual games.

**Hypothesis 4.** Learners with intuitive learning style are related to their preference on simulation games.

### 4. Experimentation

#### 4.1. Participants

This experimentation involved 51 Arabic speaking participants studying in bachelor’s degree and 23 participants studying in master’s degree in a tertiary school in Tunisia (ISIG Kairouan). The survey took place during January-April 2014.

#### 4.2. Instruments

Two instruments were the basis of this study. The first one was the Index of Learning Style (ILS) instrument developed by Felder and Soloman (1997). It was used in this study for measuring learners’ learning styles. This instrument consists of forty-
four questions and preferences of learners on learning styles are expressed with values between +11 and −11 per dimension. The ILS instrument is available at http://www.engr.ncsu.edu/learningstyles/ilsweb.html. Questions of the ILS (Appendix B) were translated in Arabic (native language of Tunisia), with the help of an English language teacher, to ensure that participants understood the questions.

The second instrument was a subjective questionnaire that was developed and utilized to discover the preferences of learners regarding the genres of games. The questionnaire was developed in Arabic. It consisted of definitions of each game genre, used in this study, followed by three statements related to the preferences for that genre. Participants were asked to provide their level of agreement on a 7 point Likert scale (1 = strongly agree and 7 = strongly disagree). Fig. 1 shows an example of the game genre definition followed by a set of statements. The full English version of the questionnaire can be found in Appendix A.

The questionnaire of preference’s on game genres included several statements that expressed the same idea with different questions. The reliability of the questionnaire’s items was checked via the internal consistency method. Specifically, Cronbach’s alpha internal consistency coefficient was calculated to test the consistency of the items. The Cronbach’s alpha internal consistency coefficient was found to be between 0.781 and 0.95 as shown in Table 2. Cronbach’s alpha coefficient values higher than 0.70 are considered as good, and when the value is close to 1.00, it is considered Excellent (Gliem & Gliem, 2003). Consequently, all items of the questionnaire were found to be consistent.

4.3. Procedure

Participants were first informed about the goals of the experimentation. In addition, participants were invited to attend a presentation about computer based games for learning, genres of games and learning styles.

The presentation introduced the participants to the fields of learning games and personalization. After that, a set of games genres was described to the participants followed by a various examples of computer based games for learning from the literature. Then, a description of Felder-Silverman learning style dimensions was presented and finally the purpose of the experimentation was explained to the participants. After the presentation, participants were requested to complete the Index of Learning Style (ILS) questionnaire and the subjective questionnaire (described earlier in the Instruments section) using pencil and paper. This concluded the survey.

After finishing the experimentation, data of those participants, who either did not respond to all of the questions of ILS or did not indicate their preferences for the genre of games, were discarded because they were considered as not reliable enough for inclusion in the survey. Data from 20 students of master's degree and 44 students of bachelor’s degree were finally used for analysis.

Values of participants’ preferences on learning style dimensions, obtained from the ILS, were divided into three groups. The first group includes values between +5 and +11 that indicate a preference for one pole (e.g. sequential). The second group includes values between +3 and −3 that indicate that the participant has a balanced learning style (e.g. balanced sequential-
The third group includes values between –5 and –11 that indicate a preference for the other pole (e.g., global). Table 3 shows the values and the learning style dimensions of each group.

Concerning the preferences on a genre of games, the values were divided into three groups, namely prefer, neutral, and do not prefer. In particular, the values between 1 and 3 indicate that the participant prefers the genre; the value of 4 indicates that the participant is neutral; and, the values between 5 and 7 indicate that the participant does not prefer the genre.

In order to determine whether a relationship exists between learning styles dimensions and preferences on game genres, a crosstab table and the Chi Square test were used in this study. In addition, when the existence of a relationship was found, a measure of association, called Cramer’s V, was used to measure the strength of the relationship between the variables.

4.4. Results

In order to answer the main question that this study posed, four hypotheses were defined. In the following subsections, the analysis of the findings is discussed for supporting or rejecting the hypotheses.

4.4.1. Sequential/global dimension

The first hypothesis to be tested is whether learners with sequential learning style are related to their preference on puzzle games. Table 4 presents the statistics results for sequential/global dimension and preferences on puzzle games.

Table 4 shows that all of participants who have sequential learning styles prefer puzzle games. On the other hand, only 57.1% of participants who have global learning style prefer this genre. These percentages support the hypothesis 1. However, there may be a possibility that the relationship between sequential learning style and preferences on puzzle game is due to the chance. To ensure that it is not the case, Pearson Chi-Square test was used. The probability of the Chi-Square test statistic was p = 0.02, less than the alpha level of significance of 0.05. Therefore, the hypothesis 1 is supported by this analysis. Finally, for answering how strong the relationship between the two variables is, the measure of association Cramer’s V was used. Results indicated that Cramer’s V value was 0.301 which means a moderate relationship.

This study also explored if learners with global learning style are related to their preference on god games. Table 5 shows statistical results for preferences on god games.

Table 5 shows that only 57.1% of participants who have global learning style prefer god games. Contrariwise, the percentage of participants who have sequential learning style and prefer god game is very high (72.7%). These statistics do not support the hypothesis 2. Therefore, our hypothesis that learners with global learning style are related to their preference on god games is rejected.

4.4.2. Sensing/intuitive dimension

Concerning the sensing/intuitive dimension, this study checked if learners with sensing learning style are related to their preference on casual games. Table 6 presents the statistical findings for preferences on casual games and sensing/intuitive dimension.

Table 6 shows that 80% of the participants who have sensing learning style prefer casual games. On the other hand, only 33.3% of participants who have intuitive learning style prefer this genre of games. Statistics support the hypothesis 3. To ensure that this relationship is not due to the chance, Pearson Chi-Square test was used. The probability of the Chi-Square test statistic was p = 0.05, equal to the alpha level of significance of 0.05. Furthermore, the Cramer’s V value is equal to 0.269 which is meant a weak relationship. These results support the hypothesis 3.

The last hypothesis explored if learners with intuitive learning style are related to their preference on simulation games. Table 7 shows the statistical results for sensing/intuitive dimension and preferences on simulation games.

Table 7 shows that 83.3% of the participants who have intuitive learning styles prefer simulations games. However, the percentage of participants who have sensing learning styles and prefer simulations games is also high (64%). Findings of Chi Square test show that the probability of the Chi Square test statistic was p = 0.20, greater than the alpha level of significance of 0.05. These results fail to support the hypothesis 4.

5. Discussion and conclusion

This study investigated the relationship between learning styles and genres of games. In particular, it considered two dimensions of FLSMS which are: sequential/global and sensing/intuitive. In order to validate the proposed relationships, experimentation was conducted. Results of this study support two hypotheses and reject two. In particular, hypotheses 1 and 3 were supported. Par consequent, this study validated the relationship between the sequential learning style and the genre
### Table 3
Segmentation of participants’ preferences values on learning style.

<table>
<thead>
<tr>
<th>Values</th>
<th>Dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1</td>
<td>11, 9, 7, 5</td>
</tr>
<tr>
<td>Group 2</td>
<td>1, 3, –1, –3</td>
</tr>
<tr>
<td>Group 3</td>
<td>–5, –7, –9, –11</td>
</tr>
</tbody>
</table>

### Table 4
Statistical results for sequential/global dimension and preferences on puzzle games.

<table>
<thead>
<tr>
<th>Learning Style (LS)</th>
<th>Prefer</th>
<th>Neutral</th>
<th>Do not prefer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Count</td>
<td>22</td>
<td>0</td>
<td>0</td>
<td>22</td>
</tr>
<tr>
<td>% within LS 100%</td>
<td>0%</td>
<td>0%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Balanced Count</td>
<td>23</td>
<td>5</td>
<td>7</td>
<td>35</td>
</tr>
<tr>
<td>% within LS 65.7%</td>
<td>14.3%</td>
<td>20%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Global Count</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>% within LS 57.1%</td>
<td>28.6%</td>
<td>14.3%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>49</td>
<td>7</td>
<td>8</td>
<td>64</td>
</tr>
<tr>
<td>% within LS 76.6%</td>
<td>10.9%</td>
<td>12.5%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 5
Statistical results for sequential/global dimension and preferences on god games.

<table>
<thead>
<tr>
<th>Learning Style (LS)</th>
<th>Prefer</th>
<th>Neutral</th>
<th>Do not prefer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sequential Count</td>
<td>16</td>
<td>1</td>
<td>5</td>
<td>22</td>
</tr>
<tr>
<td>% within LS 72.7%</td>
<td>4.5%</td>
<td>22.7%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Balanced Count</td>
<td>10</td>
<td>1</td>
<td>24</td>
<td>35</td>
</tr>
<tr>
<td>% within LS 28.6%</td>
<td>2.9%</td>
<td>68.6%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Global Count</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>% within LS 57.1%</td>
<td>28.6%</td>
<td>14.3%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>30</td>
<td>4</td>
<td>30</td>
<td>64</td>
</tr>
<tr>
<td>% within LS 46.9%</td>
<td>6.3%</td>
<td>46.9%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 6
Statistical results for sensing/intuitive dimension and preferences on casual games.

<table>
<thead>
<tr>
<th>Learning Style (LS)</th>
<th>Prefer</th>
<th>Neutral</th>
<th>Do not prefer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Count</td>
<td>20</td>
<td>1</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>% within LS 80%</td>
<td>4%</td>
<td>16%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Balanced Count</td>
<td>19</td>
<td>5</td>
<td>9</td>
<td>33</td>
</tr>
<tr>
<td>% within LS 57.6%</td>
<td>15.2%</td>
<td>27.3%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Intuitive Count</td>
<td>2</td>
<td>0</td>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>% within LS 33.3%</td>
<td>0%</td>
<td>66.7%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>41</td>
<td>6</td>
<td>17</td>
<td>64</td>
</tr>
<tr>
<td>% within LS 64.1%</td>
<td>9.4%</td>
<td>26.6%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>

### Table 7
Statistical results for sensing/intuitive dimension and preferences on simulation games.

<table>
<thead>
<tr>
<th>Learning Style (LS)</th>
<th>Prefer</th>
<th>Neutral</th>
<th>Do not prefer</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensing Count</td>
<td>16</td>
<td>3</td>
<td>6</td>
<td>25</td>
</tr>
<tr>
<td>% within LS 64%</td>
<td>12%</td>
<td>24%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Balanced Count</td>
<td>15</td>
<td>2</td>
<td>16</td>
<td>33</td>
</tr>
<tr>
<td>% within LS 45.5%</td>
<td>6.1%</td>
<td>48.5%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Intuitive Count</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>% within LS 83.3%</td>
<td>0%</td>
<td>16.7%</td>
<td>100%</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36</td>
<td>5</td>
<td>23</td>
<td>64</td>
</tr>
<tr>
<td>% within LS 56.3%</td>
<td>7.8%</td>
<td>35.9%</td>
<td>100%</td>
<td></td>
</tr>
</tbody>
</table>
of games puzzle; and the relationship between sensing learning style and games casual games. On the other hand, hypotheses 2 and 4 were rejected. For that, this study failed to validate the relationship between the global learning style and god game genre; and the relationship between intuitive learning style and game based on simulation. These promising results lead us to reconsider the negative finding by expanding the experimentation to cover a large number of participants and to relate the dimensions of learning style to others genres of games. Moreover, these results invite us to put forward new hypotheses in order to cover all FLS dimensions.

The confirmed relationships can be exploited by E-Learning recommendation systems in order to consider specific demands and preferences of learners and satisfy their heterogeneous needs. For example, adaptive E-learning systems can deliver instances of game based learning as learning objects (Burgos, Tattersall, & Koper, 2007; Torrente, Moreno-Ger, Martínez-Ortiz, & Fernandez-Manjon, 2009). These adaptive e-learning systems can benefit from the current investigations, as they benefited from previous investigations (Chen, Kinshuk, Wei, & Liu, 2011), by recommending to learners the appropriate instances of game based learning according to their learning styles. These recommendations could enhance learners’ motivation, resulting in better chances for success in learning process. Moreover, game designers could benefit from this study when designing learning games. Especially, game designers could create adaptive learning game by making it suitable for the learners’ learning styles. As an example, the designer could include several game genres features inside the learning game. After that, the learning game provides learners with suitable scenarios according to their learning styles.

Finding of this study is in line with the theoretical investigation of Rapeepisarn et al. (2008) which believes that there is a relationship between learning styles and genres of games. However, unlike the current study, the study of Rapeepisarn et al. (2008) deals with the Honey and Mumford learning style and their assumptions stayed at a theoretical level without any empirical investigation. Finding of this study also underscores the finding of Khenissi et al. (2013) that revealed a possibility of proving a relationship between the sequential dimension of learning style and the games based on puzzle. So, the result of the current study asserts the claim of Khenissi et al. (2013) and proves that relationship.

Although some of the results are promising, the research needs to be further validated as the current samples were limited and were from the same institution. In addition, the participants’ preferences on games genre need to be measured in real circumstances, after playing different games having different genres.

In summary, this study started a new research direction that focuses on finding a relationship between genres of games and learners characteristics. In particular, this study explored the relationship between two dimensions of FLS and four genres of games. Future work will enhance this study by broaden the samples and measuring the participants’ preferences on game genres in real circumstances. Additional future work will also demonstrate the benefits of using these new relationships on learner learning progress. In addition, we plan to study the effectiveness of using these relationships at improving learner motivation and engagement. The promising results given by this study may encourage researchers in this field to conduct further comprehensive investigations that cover the rest of FLS dimensions. Moreover, researchers could propose others relationships between FLS dimensions and other genres of games. Furthermore, these investigations could be expanded to cover many learners’ characteristics and many genres of games.

Appendix A

This questionnaire consists of 4 genres of video games. First you find a definition of each genre, and then you find a set of statements beside them a Likert scale consists of 7 values ranging from 1 to 7. Value 1 means that you are totally agree to correspondent statement and value 7 means that you are totally disagree. Please select a value for each statement.

1) Puzzle Game: Presented on their own without story or content action. In this genre, primary conflict is not between the player-character and other characters, but rather the figuring out of a solution.

<table>
<thead>
<tr>
<th></th>
<th>I like it.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>These games are usually complex and excite my nerves, and because of that I don’t like it.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>I find it fun to solve puzzles.</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Strongly agree</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
</tbody>
</table>
Appendix B

The Index of Learning Styles (ILS) is a questionnaire containing 44 questions, 11 questions corresponding to each of the four dimensions of the FSLSM. The aim of ILS questionnaire is to determine the learning style preferred by each learner. An initial version was created in 1991 by Richard Felder and Barbara Solomon of North Carolina State University. In 1996, a pencil-and-paper version of the questionnaire was put on the World Wide Web and then an online version was added in 1997.

Since 11 questions are posed for each of the four dimensions, the learner’s preference for each dimension is expressed by an odd integer values between +11 and −11. Each question is designed to determine if a respondent tends to belong to one category or another on that dimension. For each question 2 possible answers (‘a’ and ‘b’) are available. The total scores are
computed by subtracting the “b” responses of relevant questions/items from the relevant “a” responses. For example, if a learner chose eight of the answers classified as sequential and three of the answers classified as global, then it is sequential with a score of \(8 - 3 = 5\). Following is the full English version of the ILS questionnaire:

1. I understand something better after I
   (a) try it out.
   (b) think it through.
2. I would rather be considered
   (a) realistic.
   (b) innovative.
3. When I think about what I did yesterday, I am most likely to get
   (a) a picture.
   (b) words.
4. I tend to
   (a) understand details of a subject but may be fuzzy about its overall structure.
   (b) understand the overall structure but may be fuzzy about details.
5. When I am learning something new, it helps me to
   (a) talk about it.
   (b) think about it.
6. If I were a teacher, I would rather teach a course
   (a) that deals with facts and real life situations.
   (b) that deals with ideas and theories.
7. I prefer to get new information in
   (a) pictures, diagrams, graphs, or maps.
   (b) written directions or verbal information.
8. Once I understand
   (a) all the parts, I understand the whole thing.
   (b) the whole thing, I see how the parts fit.
9. I find it easier
   (a) to learn facts.
   (b) to learn concepts.
10. In a book with lots of pictures and charts, I am likely to
    (a) look over the pictures and charts carefully.
    (b) focus on the written text.
11. In a book with lots of pictures and charts, I am likely to
    (a) look over the pictures and charts carefully.
    (b) focus on the written text.
12. When I solve maths problems
    (a) I usually work my way to the solutions one step at a time.
    (b) I often just see the solutions but then have to struggle to figure out the steps to get to them.
13. In classes I have taken
    (a) I have usually got to know many of the students.
    (b) I have rarely got to know many of the students.
14. In reading non-fiction, I prefer
    (a) something that teaches me new facts or tells me how to do something.
    (b) something that gives me new ideas to think about.
15. I like teachers
    (a) who put a lot of diagrams on the board.
    (b) who spend a lot of time explaining.
16. When I’m analysing a story or a novel
    (a) I think of the incidents and try to put them together to figure out the themes.
    (b) I just know what the themes are when I finish reading and then I have to go back and find the incidents that demonstrate them.
17. When I start a homework problem, I am more likely to
    (a) start working on the solution immediately.
    (b) try to fully understand the problem first.
18. I prefer the idea of
    (a) certainty.
    (b) theory.
19. I remember best
20. It is more important to me that an instructor
   (a) lay out the material in clear sequential steps.
   (b) give me an overall picture and relate the material to other subjects.
21. I prefer to study
   (a) in a group.
   (b) alone.
22. I am more likely to be considered
   (a) careful about the details of my work.
   (b) creative about how to do my work.
23. When I get directions to a new place, I prefer
   (a) a map.
   (b) written instructions.
24. I learn
   (a) at a fairly regular pace. If I study hard, I’ll “get it.”
   (b) in fits and starts. I’ll be totally confused and then suddenly it all “clicks.”
25. I would rather first
   (a) try things out.
   (b) think about how I’m going to do it.
26. When I am reading for enjoyment, I like writers to
   (a) clearly say what they mean.
   (b) say things in creative, interesting ways.
27. When I see a diagram or sketch in class, I am most likely to remember
   (a) the picture.
   (b) what the instructor said about it.
28. When considering a body of information, I am more likely to
   (a) focus on details and miss the big picture.
   (b) try to understand the big picture before getting into the details.
29. I more easily remember
   (a) something I have done.
   (b) something I have thought a lot about.
30. When I have to perform a task, I prefer to
   (a) master one way of doing it.
   (b) come up with new ways of doing it.
31. When someone is showing me data, I prefer
   (a) charts or graphs.
   (b) text summarizing the results.
32. When writing a paper, I am more likely to
   (a) work on (think about or write) the beginning of the paper and progress forward.
   (b) work on (think about or write) different parts of the paper and then order them.
33. When I have to work on a group project, I first want to
   (a) have a “group brainstorming” where everyone contributes ideas.
   (b) brainstorm individually and then come together as a group to compare ideas.
34. I consider it higher praise to call someone
   (a) sensible.
   (b) imaginative.
35. When I meet people at a party, I am more likely to remember
   (a) what they looked like.
   (b) what they said about themselves.
36. When I am learning a new subject, I prefer to
   (a) stay focused on that subject, learning as much about it as I can.
   (b) try to make connections between that subject and related subjects.
37. I am more likely to be considered
   (a) outgoing.
   (b) reserved.
38. I prefer courses that emphasise
   (a) concrete material (facts, data).
   (b) abstract material (concepts, theories).
39. For entertainment, I would rather
   (a) watch television.
40. Some teachers start their lectures with an outline of what they will cover. Such outlines are
(a) somewhat helpful to me.
(b) very helpful to me.
(c) does not appeal to me.
41. When making long calculations,
(a) I tend to repeat all my steps and check my work carefully.
(b) I find checking my work tiresome and have to force myself to do it.
42. When solving problems in a group, I would be more likely to
(a) think of the steps in the solution process.
(b) think of possible consequences or applications of the solution in a wide range of areas.

References


