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# An Inclusive Framework for Developing Video Games for Learning

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**Abstract:** Games are a type of vehicle with which society is changing at present-day. But how the games themselves will be changed by society, is an interesting question to ask for enhancing and initiating better design of games. As participation in gaming upsurges around the world and across a larger part of the population, it is obvious that games are not only an entertainment medium for children or young people anymore. Games can be used to accomplish different purposes for different groups of people in the society. Design and use of games for learning and/or educational purpose has been an important research field for several years. However, this research field is yet to deliver expected achievement and result, despite of many efforts and resources put into it. Factors that are important to consider for designing a game that will motivate users to active involvement in playing a game for active learning, are crucial for the successfulness of the design of such game. The design goal for educational games would be to produce games that motivate users and thereby achieve effective learning. This paper proposes a framework in which the parameters of what users want from a game are considered for the development of games for learning. The framework is based on the previous research and theory of Richard Rouse (2001), who defined different dimensions of game design in terms of learning. The proposed framework is important in order to investigate and assess the success of existing games used for learning. Also the framework can provide better understanding as a requirement engineering tool for game designers, who are to design games for learning and educational purposes in the future. The proposed framework was verified using a small quantitative analysis. It was found that, while some parameters of the framework indeed have significance for designing games for learning, there are additional factors that need to be discovered by further analysis and research to enhance the usability of the framework.

**Keywords:** games and learning, inclusive games design, inclusive framework for games design, educational computer games.

## 1. Introduction

At present digital gaming has become a part of our culture. The gaming industry too is an interesting and important issue in terms of commercial values. This industry is rapidly growing and we see the expansion of gaming industry in last one decade in a totally different manner, since hardware improvement has come about rapidly and prices become affordable by large population using computers. "Academia and also Research & Development over the last years have started to focus on 'serious games'" (Kellogg, Ellis & Thomas, 2007). "Leading experts speak of 'creating a science of games' (Zyda, 2007), (Kellogg et al., 2007) with the goal of implementing games and game-like interfaces of general importance for a growing number of applications and as a general trend in the design of Human-Computer Interfaces (HCI)" (Kellogg et al., 2007) (Archambault, Gaudy, Miesenberger, Natkin & Ossmann, 2008). Using computer games as a tool to create an effective learning environment is not a very new concept. Also, general human computer interaction has already begun to use different methods and concepts that were derived from games, since these can increase the usability level (Archambault et al., 2008). While enhancing usability, games or interfaces reflecting game-like environments are quite accepted and known as means to implement educational, training, general HCI and web applications effectively (Archambault et al., 2008). For example, Archambault et al. mentioned some areas of interest of games, one of them being "eLearning and edutainment which more and more implement or use didactic games" (Chatham, 2007), (Archambault et al., 2008). "As an example of this trend it should be noted that critical issues like mathematics and science education are approached with game-based learning infrastructures and edutainment to address the well-known didactic problems in this domain" (Archambault et al., 2008). It was found in previous researches that playing computer games can stimulate chemical changes in the brain which in turn can promote learning (Archambault et al., 2008), (Mayo, 2007). However, the rate of learning will be highly dependent on how well a game is designed to serve that purpose. That is, to get effecting learning outcome using a game, that game should also be designed effactually, or else the intended purposes will not be served. That is why not all games can be used to educate students. Although issues like how an educator will use a game to teach, how well the student and learning environment integrates together etc. are some factors that have direct impact on learning, most importantly the platform of learning (game in this case) has the highest significant impact on pupil's

mind regarding the issue of how they are learning. Also as society ages and the care gap increases, technology is envisaged as a means of allowing older people to live independently for longer. For this focus group, for instance, designing games has already been a challenge, not to mention the fact that designing games for learning for this audience is more challenging. Therefore, in the upcoming future, where computer games are a major recreational activity as well as a tool for attaining tasks like learning, education, content delivering etc., a mass market of computer games not too different from what we now have should focus on 'appropriately designed' games. Appropriateness of the design would then unlock the possibility of making games complete in and on their own and self-sufficient. Nevertheless, use of games in education has been a debatable issue for decades and lately a lot of research has been going on in this field of interest. In this paper, we propose a framework for developing games that should be optimal for learning. As of the authors' knowledge, to date there is no certain framework or model or any design principles available to follow with which successful design of games for learning can be achieved. The proposed framework in this paper thus opens new research opportunities and also brings present research of games and learning into a new standard.

## 2. Background

While accessibility generally addresses issues with physical disabilities or limited physical or psychological ability for accessing any service or product, 'game accessibility' can refer two things. Either the game is not properly designed for a target user group who suffers from different kinds of disabilities or, regardless of physical or psychological disability issues, a game can be designed in such a manner that it is not accessible by some group of user simply because it is not usable or useful to them. Designing inclusive games can be a solution for the first issue. Designing usable games for accomplishing a set of tasks should be the solution for the second issue that is addressed here. We would like to argue that, to accomplish successful learning using games, it is important to design games with a certain purpose properly. This would allow the most possible groups of users to be included in using the games for learning, for example. The game industry would also lose potential users and profits if the game is excluding certain groups. This paper takes into consideration some parameters that users expect from games while they are playing it, and uses these parameters to propose a framework called 'Inclusive framework for developing games for learning'. The motivation behind the proposed framework is the universal design concept, also known as inclusive design or design for all. Universal design is a concept which is getting more and more widely supported and the present challenge is to mainstream universal design. If we want to use games for learning properly, the first task is to design proper games for learning. For this to be achieved, one challenge will be to include user's needs under the concept of inclusive or universal design. Hence, by mainstreaming the design for all concepts of computer games design, it could be quite possible to design games properly to serve the purpose of optimal learning.

### 2.1 Games and Education

The argument of why the use of games in education is important is a conflict-ridden question. "Play is definitely one of the most important psycho-pedagogical concepts, consequently games, used in an appropriate setting, can be used as splendid educational tools" (Goodman-Deane, Keith & Whitney, 2009). The primary reasons behind the use of games in learning and education are that games can be superior, cheaper and safer than other learning approaches. However, while games are considered to be a product, there exists a rise of relationship to diverse categories of products within education and learning. Also, this in return explains the dimensions of game design where 'purpose of design' and 'purpose of use' of a product such as a game is considered. The three dimensions interconnected and operating with each other in game design are story fiction, game play rules and technology platform (Rouse, 2001). Bowman (1982) contrasts video gamers, "engaged in states of flow", with students in "traditional school environments". "Students in traditional teacher led classes have little control over what they learn, are passive recipients of material chosen by teachers, must conform to the pace and ability level of the group (group instruction), and are given shallow, imprecise, normative feedback on their work" (Squire, 2003). Here computer games represent new cultural forms with which young people are increasingly familiar and fluent. Games also suggest that educational systems should not remain something static or traditional on transferring to the young, since their learning skills and practices are more suited to the 21st century than anything schools prepare them for (Beavis, 2002). Recent studies suggest that when young people are playing games, they are engaged in learning activities that are more complex and challenging than most of their formal school tasks. The foundation for this claim can be divided into three basic pillars: games as

challenging learning environments, the type of things players can learn through game play and last but not least the social factors that contribute to learning through games.

## 2.2 Game as a tool for learning enhancement

Garris, Ahlers and Driskell (2002) described a tacit model of learning that is important to have an understanding of when studying games. The goal is to design a game that incorporates certain characteristics and features. These features trigger a cycle that includes the user's reactions and judgments such as interest and additional system feedback. If well-designed, the instructional content will be paired with appropriate game features and this iterative cycle results in self-motivated and recurring game play. The end result is that this engagement in game play leads to the accomplishment of specific learning outcomes and training objectives (model depicted in figure 1). A defining characteristic of computer game play (as described by the game cycle process) is that users are engaged in repetitive play and return to the game over time. It is this feature of game play that game developers and designers should hope to capture and incorporate. Research has revealed that learning can be more effective if it is characterized as fun by the learner. Also, if the educational assignment is set in a motivating context the learning outcome is enhanced and aided. A game that can provide a meaningful context for the learner will therefore have a positive effect on the learner's motivation and learning (Cordova & Lepper, 1996). If the learner is engaged and actively interacts with the game, learning will be done effectively. Cordova and Lepper's result showed that powerful educational benefits could be gained if intrinsic motivational appeal of learning activities for learners is increased with the right design (for example if the learner has large control and can manipulate the context to be more personal). As Garris et al. (2002) write, the goal to be achieved is motivated learners, who are focused, enthusiastic and engaged. The game should bring curiosity to the user, since curiosity is considered to be an important driving factor for learning (Malone & Lepper, 1987). The users crave an optimal level of challenge; they are best challenged by activities that are neither too easy nor too difficult to perform (Malone & Lepper, 1987). The rules of a game describe the goal structure of the game. Another important factor influencing motivation and active game play is that how specific, clear and difficult the goals are provides enhanced performance (Locke & Latham, 1990). The theme, characters and context that buildup the game will stimulate fantasy (Garris et al., 2002) and are also important in order to achieve educational effectiveness. The game interaction needs to incorporate good feedback as an assessment of progress towards the goals that motivate the user to devote more effort (and thereby learn more) (Garris et al., 2002). The educational game therefore needs to be designed very carefully to achieve effective learning by increasing the relevance and motivational force of the game for the learner.
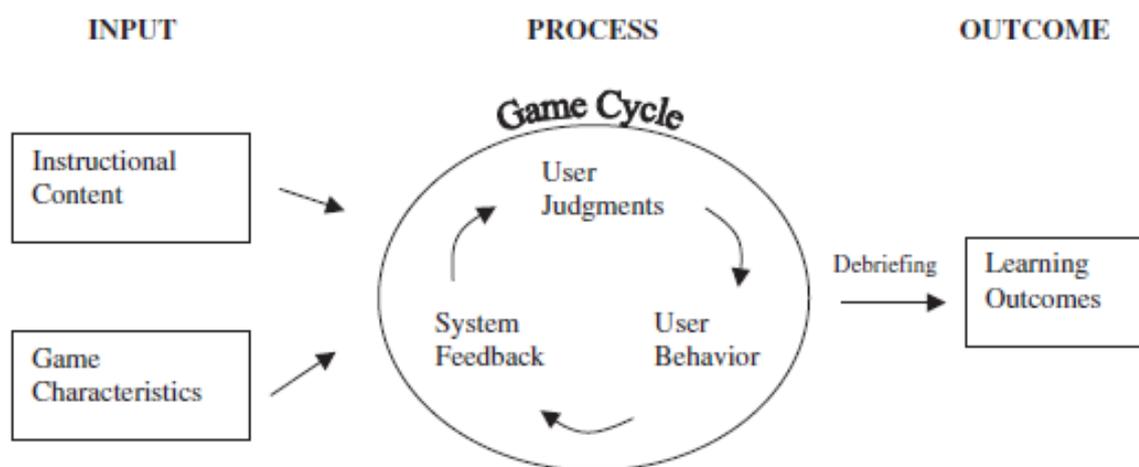


**Figure 1:** Game based learning model (from Garris et al., 2002)

The educational content can for instance be a part of the games theme or it can emerge by interacting with the rules of the games. Since interactivity adds realism and fun is crucial for learning, the content could also be considered for the story fiction dimension. That would open for the opportunity of multimodal representations in this dimension as well. Interaction with the rules forces the user to conduct a certain activity. Hence, rules of a game can be educational content too and therefore, that can also come from interacting with that specific knowledge. Technology is used for several issues while using games for learning, for example economical or safety issues. Simulators are a good

example of this dimension. However, the three dimensions of games design in terms of learning stated by Richard Rouse (2001) is the basis on which the framework of this paper is proposed. The following section introduces the framework and explains it further.
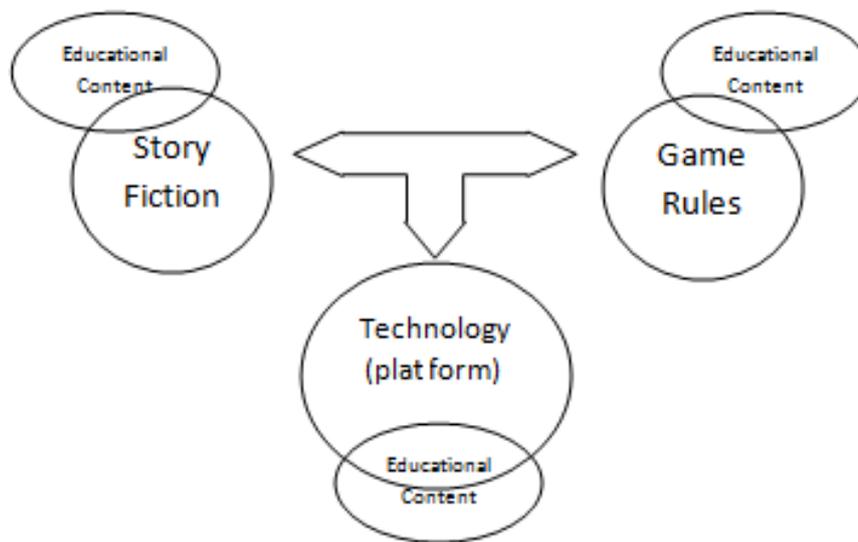


**Figure 2:** The dimensions of game design (Rouse, 2001)

## 3. Proposed Framework

We in this paper argue that it is also important to consider what users want, while they are playing a game for learning or educational purposes and not only for entertainment reasons. Why a user will switch from a traditional learning approach, to game-based learning, can be answered only when we know what the requirements from users are for a game to be a called a learning tool. Also it is important to find out whether or not a game is designed based on users' requirements. The three dimensions showed in figure 2 give an abstract idea about the reasoning for games design, for educational content and learning. While considering several other factors of what users want, the dimensions can take a different paradigm. Several factors, as Rouse (2001) says "a never ending list", are out there, but while considering designing games for learning, some factors can be narrowed down and included into a framework which would give a better understanding of user requirements for designing games for learning. The proposed inclusive framework for developing games for learning is shown in figure 3. This framework gives a wide-ranging initiative to the developers or designers of games, whether or not they are considering the important factors asked from the users' end, before and during the game development phases. It can also be used as a verification tool to examine the success of any existing game as a learning tool.

The different view of three domains on the proposed framework takes several factors into consideration as parameters. These parameters consent for game designers to consider several aspects during game design. Different types of interaction in computer games and how to control games in different ways for different user groups are some examples. Since we include several different parameters in three different domains (figure 3), we title the framework to be inclusive. The argument of inclusive games design can be seen from a different perspective from this framework. That is, designing games inclusively does not necessarily mean only creating a design for giving the users better accessibility (physical limitation in most cases) – inclusive games can also refer to a design that considers and includes several factors to enhance better accessibility towards a specific goal, in this case learning. The framework aims to design games successfully in terms of successful learning ability through the games design. Also the user's satisfaction by the successfulness and purpose served by the game design (learning) can lead towards a sustainable design solution of games for learning. The whole game design process can then be iterative in nature and sustain with time.
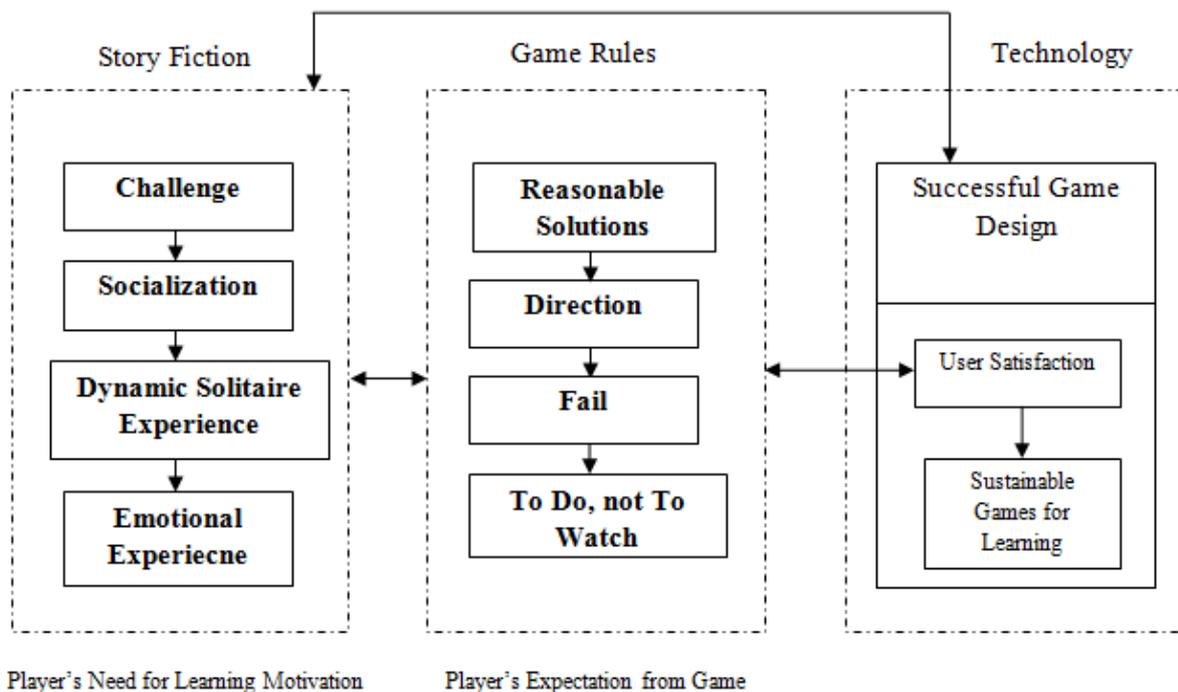
**Figure 3:** Inclusive framework for developing games for learning

As seen in figure 3, the three dimensions of game design from Richard Rouse (2001) are mapped in a different framework with several parameters, hence entitled an inclusive framework. Users' needs from a game in general are challenge, socialization, a dynamic solitaire experience along with emotional experience (Rouse, 2001). These needs can be plotted into the story fiction domain. However, users' expectations are to find a reasonable solution and/or a direction towards finding the solution. In failing to achieve a solution and while trying to solve a problem they do not need to be watched, rather they need to do it (Rouse, 2001), which raises the challenge. These needs are in turn mapped into the game rules domain. Together, these parameters can achieve users' satisfaction. A combination of these two dimensions can lead towards optimal and sustainable games design for learning, which is mapped in the technology domain. If user satisfaction is not achieved, reverse engineering can rebound to the game rules dimension to find missing elements. In the same manner, if the game design is not successful, it can go back to the story fiction dimension to find the remedy. Story fiction and game rules work with each other while considering user satisfaction and successful game design for creating sustainable games for learning.

Too, as mentioned earlier, an existing game that is being used or going to be developed as a learning tool for education can be tested to predict how usable the game will be to use for learning and similar purposes for different user groups, using this framework. It allows for a single game to be tested against or redesigned for different user groups. During the prototype design or user testing phase of a game the parameters described in the framework can be tested and thereby altered if needed. A game with a good challenge towards accomplishing a task may produce a successful game in terms of design, where a lack of proper direction showing would make the purpose useless. That is, the user might not learn from the game at all, which results in a non-usable educational game. A customized learning game for achieving certain purposes can however alter the parameters of the first two domains if needed, meaning the parameters in these domains can be dynamically based on the situation – the need and target groups. For instance, from pedagogical perspective, a game that is designed for the age group 5 to 10 might not focus as much in socialization than on challenge. For this age group, playing games for fun is important, which is why they admire challenges. Again, the goal of a game for the same user group could be defined to be a sustainable one (a game designed to act towards its purpose over time), based on other different parameters. A learning tool for older adults however might need both socialization and dynamic solitaire experience, in order for the users to learn something properly from the game, thereby achieving user satisfaction and sustainable games design in the long run. To validate these arguments, we needed to collect empirical data from user groups and see which parameters work optimally towards achieving our goals.

## 4. Case study and findings

In autumn of 2011, a small quantitative study was conducted at the University of Maryland, USA by the authors. The goal of the study was to pinpoint what gamers require of a game to call it a successful game for learning. A quantitative field experiment with 67 participants was thus conducted, where the basis for the analysis was questionnaire responses. The questionnaire items were designed to capture the variables that make up the framework in figure 3, in measuring its eight parameters. Basic demographic information has been collected from the participants. Around 67% of the participants were male and 33% of the participants female, with age ranging from 16 to 24. Most of the participants were students at Maryland University. The 67 participants of this study were hardcore computer and video game users. None of the participants had any kind of physical or mental disability that could affect controlling and understanding the games. Some participants reported common eye problems not relevant to the effect on the purpose of this study. The participants ranked answers on a scale of 1 to 9 to express how strongly they believed themselves to be hardcore gamers. Data on the amount of time they spent per week playing games was also collected. The aggregated values of the 24 questions of the survey were then analyzed and coded in to SPSS (version 19) and statistical operations were run to derive results. Our results showed that users liked the idea of socialization, challenge and reasonable solution. However, some of the participants replied that they like to watch other users playing games and do not mind doing so. Achieving a goal and emotional experience was less prioritized by these participants. Direction was noticed to be an important issue among the participants, but we did not find a correlation between direction and any other variables from the game rules domain. This made direction less significant in use of video or computer games for learning. Our findings showed that challenge, socialization, solitaire and emotional experience were in regression. These four factors resulted in a one factor solution in a factor analysis. This single factor showed to be the representation of story fiction. The scree plot from the factor analysis is shown in figure 4.
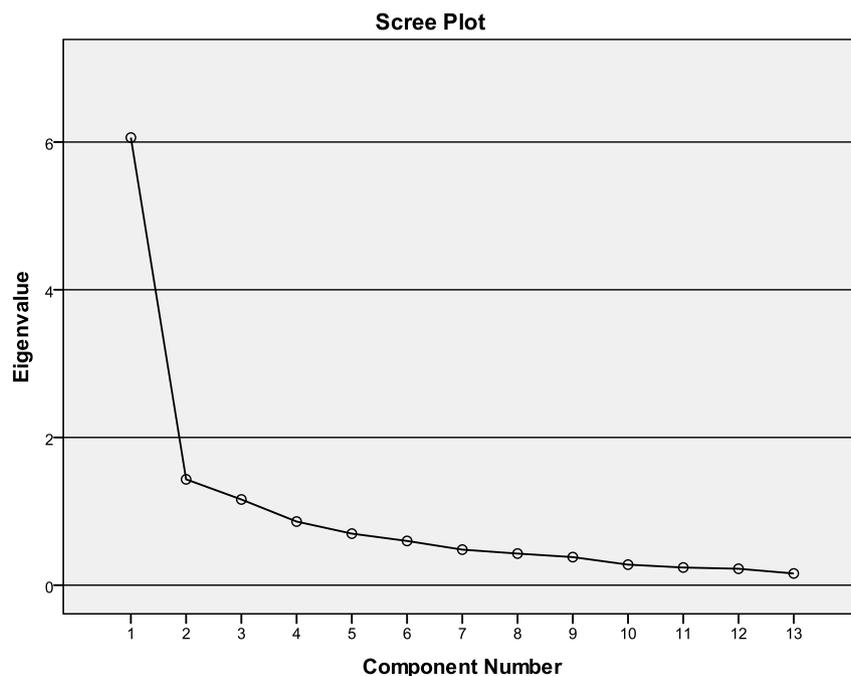


**Figure 4:** Scree plot showing tend towards one factor solution story fiction

Participants in this study revealed some interesting requirements while we conducted our study. Our findings showed that players believe challenging games to create some kind of demands that are important for learning. They make the task doable even though it is difficult to some extent. Games are quite central to friendship culture. Players can exchange their views and knowledge not only locally but through the internet among differently geographically located groups, which also is an important factor to consider for learners to motivate learning through games. Players experiencing what it is like to inhabit particular alternative identities, such as military medics, warrior trolls etc., was also an important factor to motivate players to learn via games. Therefore a new way of experiencing solitariness and emotion (finding identities) was a key factor for the participants of the study in

motivating them to play games for learning. According to the participants, players should from the feedback supplied be able to learn how their actions have caused particular effects. Also participants thought that players need to be absorbed in meaningful activities via games. In doing so, the aims and goals could be clearly understood by the players. A need for constant 'assessment' of progress and accomplishment was reflected by the participants (direction). Using a game in the classroom should not necessarily need players to be 'trained' beforehand; that is, players should be allowed to practice playing, often by failing, revising and re-trying tactics. Tasks the players needed to accomplish should be related closely to real-world practices and concrete experiences (to do, not to watch). We came to a few conclusions from the above findings, from where we derived some factors that can improve design of video games for learning more significantly. These findings are shown in an evaluation matrix form in table 1.

**Table 1:** Evaluation matrix of the computer games design for learning

| Questions | Resulting Matrix |
|---|---|
| Can I trust the game to be accessible for learning? | Design computer games more trustworthy by giving motivation to the user |
| Is the game itself easy to learn? | Improve the learning experience, without too many confusing details |
| Can I socialize during my play and learning through play? | Making use of social functions during play to create a socio-entertaining experience |
| Will I be able to handle the challenge of the game, while accomplishing the learning task at the same time? | Giving more confidence to the user about game rules and technology with minimal effort through the game design |
| Is this emotional experience intended for me? | Explaining the benefits, purpose and appropriateness of the games to the users |
| Can I detect errors while playing the game? | Making the error evaluation ability higher using game rules |

## 5. Conclusion

The proposed framework maps the theoretical framework from Richard Rouse (2001) into an inclusive framework for designing games for learning. The proposed framework considered several parameters that were not mentioned in previous game design dimensions, which actually gave an unclear understanding of what one actually should do to design a successful game for learning, or how to even evaluate successfulness of an existing game designed for learning. To make use of computer games as a good learning tool, it is important to understand that the users are active and motivated while playing the game. Once they are active users of a learning tool like a game, they can learn actively. To make users active during game playing, it is thus critical to consider their needs and expectations while designing the tool (games). This paper's framework opens the path for successful design of games for learning. It was statistically verified in our initial study and shows that the framework is not an insignificant one. The introducing question posed in the beginning of this article was therefore answered and verified to a certain extent by the proposed framework. Some parameters addressed in the framework are indeed significant in creating user interest for playing games for learning. Further testing with users and game developers would allow the successfulness and validation of this framework to be statistically measured more elaborately, in order to improve it with additional parameters.

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