Supporting Teachers in the Process of Adoption of Game Based Learning Pedagogy

Valérie Emin-Martinez, Muriel Ney

Supporting Teachers in the Process of Adoption of Game Based Learning Pedagogy

Valérie Emin-Martinez[1], Muriel Ney[2]
[1] S2HEP – EA 4148, Institut Français de l'Education - ENS Lyon, Lyon, France
valerie.emin@ens-lyon.fr
[2] Laboratoire d'Informatique de Grenoble, CNRS, Grenoble, France
muriel.ney@imag.fr

Abstract: In an attempt to address the difficulty to integrate Game-Based Learning (GBL) in the teaching practices, this paper proposes a model for the process of teachers' adoption of games, based on a first research work which led to a structured question matrix designed to foster teacher reflection on key issues that arise during this process. We focus on formal education and consider not only digital (educational) games but also other game-like activities such as role-plays and simulations. In tackling the matter of adoption, this paper addresses a key issue: How does the adoption process unfold when teachers introduce games in their classes for the first time? To answer this question, Roger's "Diffusion of Innovations" theory was used as the conceptual framework for analysing a case study. The case study took place in France with a group of six high school teachers who introduced three different games, in teams of two. We also provide different tools to support the adoption process: resources, activities, questionnaires, pedagogical scenario, patterns of activities and scenarios. Our efforts to support teachers' adoption and use of GBL are not designed to offer a one-size-fits-all solution. Rather, they are aimed at providing tools to foster reflection and facilitate the adoption process. It is hoped that this work will help overcome some teachers' resistance to GBL, and this will be the subject of further verification.

Keywords: Game Based Learning in Teaching Practices, Teacher Adoption, Serious Games, Technology Enhanced Learning, Pedagogical Scenarios

1. Introduction

Although Game-Based Learning (GBL) and digital learning games have been promoted and encouraged in recent years for formal learning, teachers still find it difficult to integrate this approach and tools in their current teaching practice (ProActive 2010). This study concerns teachers involved in integrating games into their class, not only digital games but other game-like activities such as role-plays, simulations, etc. This work was initiated as part of the activities of the European Team Game Enhanced Learning (GEL http://www.gel.itd.cnr.it/) funded by the European Network of Excellence STELLAR (De Freitas et al . 2012). This team consisted of six partner institutions also members of the Network of Excellence on serious games (GALA Games and Learning Alliance http://www.galanoe.eu/).

Teachers involved in Game-Based Teaching (GBT) have to choose a content adapted to the use of a game, to browse, test and select games, to design a pedagogical scenario, to facilitate the flow of the game, to ensure learning and assessment... These tasks represent a heavy burden for teachers who are new to game-based learning and lead them to reflect on several issues (Hanghoj & Brund 2010, Kebritchi 2010): Why teaching with a game, what type of game, what skills will students develop, how to teach with a game, how to assess learning ... ? Answering these questions may help a teacher to create an educational potential around a game, because the learning does not come directly from a commercial game, which only provides the context for the learning experience.

These issues are addressed in the literature from different perspectives: factors related to the intention to adopt games (Grove et al. 2012), the reasons and motivations for adopting games (Wastiau 09), different types of games (Garris 2002, De Freitas et al. 2006, Casares et al. 2010), different issues of pedagogy - scenario design, assessment, etc. - (Pivec 2009, Sandford et al. 2006 Wastiau 09). There are also comprehensive guides for teachers who want to introduce games, such

as reports of national and european projects: Proactive (PROACTIVE 2010), Schoolnet (Felicia 2009, Wastiau 2009, Blamire 2010), and Futurelab (Ulicsak & Wright 2010). These reports provide guidelines for teachers to develop scenarios, choose an appropriate game, conduct a session including a game and example of games that have already been used and evaluated.

In a previous work (Ney & al. 2012) we have realised a structured question matrix to identify a set of relevant questions for teachers to consider in preparation for adopting GBT approach. The first step in producing the question matrix was a literature search to ensure suitable scope and focus. Subsequently an empirical study was conducted with teachers to gauge the matrix's usefulness for practitioners new to GBT and its soundness when set against the experience of those who had already used games in class. The resulting matrix (Ney & al. 2012) includes the following six sets of key issues that are further detailed in a number of questions: (A) teacher motivation and needs, (B) learners' characteristics (as a group or individually), (C) contents and game features to address teachers' needs (game motivational factors, etc), (D) practical needs (from the institution, colleagues, etc), (E) design of the pedagogical scenario and (F) assessment and capitalization issues.

Therefore one can find in the literature many resources devoted to teachers. One may also study the process of integrating games itself, from initial awareness of game-based learning and teaching to appropriation of such a pedagogy and finally to its regular use.

2. Research Question and Theoretical Framework

The prime purpose of this research is to model the process of game adoption for individual teachers. A theory widely used to analyse the adoption of an innovation in various fields is the Rogers' theory of diffusion of innovation (Rogers 1962, 2003). An innovation is defined as an idea, practice or object perceived as new by an individual or a group. Diffusion is the process by which the innovation is communicated and adopted by the members of a social network. In our case, the innovation is the introduction in learning activities of game-based approaches including the use of digital games. Here we leave aside the sociological aspects of the diffusion of innovation in a group, and we focus on the relationship between the individual teacher and the innovation.
Rogers' theory has been applied to various applications in educational technology (Berger 2005, Martins 2004), including serious games. In the latter case, there is for instance the study of (Kebritchi 2010) that focused on the factors that facilitate or inhibit the adoption process.
Rogers describes the "innovation-decision" (or adoption) process in five stages, as shown in Figure 1 below.

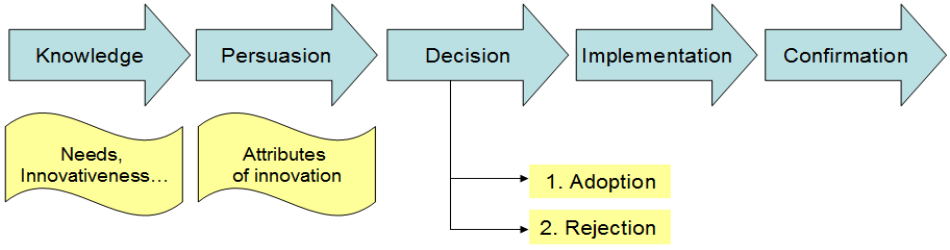

Figure 1: A model of stages in the Innovation-Decision Process (Rogers 2003, p 163)

During the *knowledge* stage the individual becomes aware of the innovation without having the goal of its adoption. Three types of knowledge are proposed in this theory: awareness-knowledge (knowing about the existence of the innovation), how-to-knowledge (knowing how it works), principles-knowledge (knowing the underlying principles). In the *persuasion* stage, the individual begins to focus on the possible adoption of the innovation and to actively seek information (see innovation attributes in Table 1). He/she forms an opinion and this gives an emotional dimension to this stage. The *decision* stage is when the individual engages in activities (analysis, debate, testing, etc.) to assess the advantages and disadvantages of the innovation; these lead to the final decision to

adopt or reject it. Then, the *implementation* stage leads the individual (who may or may not be the one to have made the adoption decision) to introduce the innovation in daily practice. This implementation opens the way to reflection about the innovation's positive and negative effects and evaluation of its usefulness in terms of the cost/benefit ratio. Finally, a *confirmation* stage takes place whereby individuals obtain information that reinforces their choice (adoption or rejection) and the sustainability of this choice. This stage involves both the individual and the group that will seek to confirm this choice.

In addition to these five stages, Rogers' theory also describes this process in terms of five elements: the types of innovator (innovators, early adopters, early majority, late majority and laggards), the perceived attributes of the innovation (different ways in which innovation can be perceived - see Table 1), the communication channels (how the innovation is transmitted from one individual to another), the social system (the group of individuals involved, how they are related, their roles, institutions, etc.) and temporal factors (the duration of each stage of the process and the rate of diffusion among members of a group).

The "perceived attributes of an innovation are one important explanation of the rate of adoption of an innovation" (Rogers 2003, p 206), it explains "49 to 87 percent of the variance in rate of adoption" (Rogers 2003, p 206). Table 1 lists these attributes and their definition by Rogers.

Table 1: Perceived Attributes of Innovations (Rogers 03)

Relative advantage	"is the degree to which an innovation is perceived as being better than the idea it supersedes".
Compatibility	"is the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters".
Complexity	"is the degree to which an innovation is perceived as relatively difficult to understand and use".
Triability	"is the degree to which an innovation may be experimented with on a limited basis"
Observability	"is the degree to which the results of an innovation are visible to others".

3. Case Study in France

3.a Description, Context and Method

The Scen@TICE team at the French Institute of Education comprises researchers and teachers of sciences and technology dedicated to the topic of innovative pedagogical scenarios using digital technologies. In 2011/2012 the team conducted field research on the use of serious games to teach sustainable development with a multidisciplinary group of teachers. This experiment involved six teachers from three schools in three different locations who worked in pairs with students from 14 to 16 years old. The subject matters were engineering, technology and biology. These teachers were compensated for their research work; they are regular users of ICT both for themselves and in the classroom, and are motivated by active pedagogies. Using Rogers' terms, we can qualify these teachers as "early adopters" or even "innovators".

The Scen@TICE team worked in several ways: plenary (focus group) meetings were held in Lyon to compare experiences and scenarios produced in each institution and discipline; several meetings in each school helped implement a common scenario by pairs of teachers.

Monitoring was done remotely: by exchanging emails, conference calls, shared documents on a web platform and scenario design with the online scenario editor ScenEdit (Emin 2010).

At the end of the year, we carried out interviews using a double interview technique (Clot, 95). The interviewee was told to imagine that the interviewer was also a teacher and was intending to introduce games in class. The interviewed teacher was prompted to tell the "colleague" (played by one researcher) anything considered important for someone who is going to use games for the first

time. Each of the six teachers was interviewed from 20 to 45 minutes. The answers were recorded, transcribed and analyzed. In order to also have the point of view of teachers involved in GBT, we have interviewed two teachers who are experienced users of games in class and have been using them for several years, including board games or card games and who have designed long-lasting games. We call them "experienced teachers". The six others were using a game in class for the first time. Therefore practices and beliefs of the teachers were variable.

3.b Results

First, we used the interviews to analyze teachers' perception of game-based learning and teaching with the aim to identify how each of the five Rogers' attributes translates in the case of GBL. For that, we extracted verbal indicators of these attributes in teachers' discourses (see Table 2). Furthermore, we suggest (Table 2, third column) factors that may help a teacher get a positive perception of GBL, and in turn a better likelihood of adoption. Table 2 aims to be a reflexive tool for anybody who wants to support teachers in adopting GBL.

Table 2. Perceived Attributes of Innovations and corresponding indicators in GBL

Perceived Attributes of Innovations	**Teacher's perception (verbal indicators)**	**External factors that may favour a positive perception from teachers**
Relative advantage	Motivation (teacher and learner), perceived benefit and cost compared to usual practice	Teacher motivation and needs and game features that answer to these needs.
Compatibility	Audience issues, values, beliefs, needs, pedagogical approaches used in the past	Game mechanisms and motivational factors (competition, collaboration, gain etc). Specificities of the learners.
Complexity	Perceived complexity of the game rules, of the scenario	Recommendations, assistance, tutorial, work in groups of teachers
Triability	Teacher tries the game as a learner.	Evaluation version of the game, easy identification of domain knowledge and rules of the game
Observability	Perceived effect of the innovation in learner's knowledge or behaviour	Evaluation report of past experiences with this game

Moreover, by counting the questions that were mentioned spontaneously by almost all teachers (at least 7 out of 8), we obtain an "a posteriori" profile of our sample of teachers: the teachers share the motivation to use a GBL pedagogy to solve a specific educational problem (but different from one teacher to another) and to target specific learning goals (2 of the 11 motivations of our question matrix, Ney & al. 2012). They look at the curriculum coverage of the game and its scientific validity and use games that include competition and goals among all the motivational factors (Mariais & al. 2010). They use existing games and work with other teachers. They tackle issues about assessment. By contrast, factors that were never mentioned by any of our eight teachers were: - use a game with the aim to foster creativity and imagination - or with the aim to prepare students for the digital society of tomorrow, - choose a game that uses chance and mystery as motivational factor - or a game that proposes emotionally rich experiences, and - create a new game using a model (authoring tool).

Then if we look at what the two experienced teachers have brought to our analysis, by contrast to

the six novices, we find the following: they are the only ones to adapt existing games to their needs or to create new games and they evoke the time constraint. They work in larger teams that may include teachers from other schools (e.g. via forums), or some of their students. These teachers have moved over the years in the adoption process (Figure 1).

The analysis of these interviews raised other points of discussion that could be investigated further. First, adoption of GBT may depend on the discipline. For example, the adoption of games for teachers in Biology is coming "naturally" through inquiry or observations of the natural world (real or virtual). In History and Geography, a special entry is the treatment of societal issues, also possible in Biology (e.g. on themes like ecology, energies, sexuality ...). In Technology, it is the methodological skills (e.g. problem solving) and debates on values (e.g. sustainable development) that seem to favour adoption of games.
Another issue discussed in the interviews is the one of the acceptance of games: students themselves can reject it, but also colleagues, parents, and the institution. Another point is that not all teachers agree on the fact that the game will help students with learning difficulties: for some teachers this is the case, because games can highlight abilities not usually favoured at school, for other teachers these students will spend all their time playing without stepping back and learn. On the other hand, good students can also reject games because there are not anymore in a position to use their winning strategies.
Teachers have also stressed the need to provide clear rules to students, but also to take the time to explain this change in their pedagogy. Finally, it seems to be necessary to test the game by putting oneself in the position of the player, which can be difficult for teachers who are not regular digital games players.

In a second phase, we have used the stages of the theory of Rogers as a reading grid to analyze a posteriori the case as it unfolded over time.
Table 3 lists the different tasks performed by teachers from the Scen@Tice team and links them to Rogers' adoption process.

Finally, we analyze the case both through the lens of Rogers' attributes of innovation (Table 2) and stages (Table 3):

- *relative advantage* : this criterion could refer to the increased motivation expected of students and to the teacher's motivation to do something new and "better" compared to previous practice (lab work, project-based pedagogy, inquiry-based pedagogy). This emerged from the *knowledge* stage and the first focus group about the questionnaire.
- *compatibility*: the game (and the GBL approach) must remain in line with the values of teachers and students, the curriculum and the quality of graphics they are used to; hence a pre-selection of candidate serious games was performed during the *persuasion* stage (examples from the interviews: teacher rejection of a game involving killing humans or produced by an oil company, choosing a game because it questions the social pillar of sustainable development, or rejection by some students of a competitive game). This notion of values present in Rogers' theory but absent in Kebritchi (2010) seems to be in our case a crucial attribute that may lead to adoption or rejection of a game, and maybe of GBL.

- *complexity*: the game should be simple and intuitive for the learners, the teacher must have ready access to the game's domain knowledge to assess its scope and depth. Complexity is also about: changing role (teacher becoming a player or a facilitator), different experience from one learner to another etc. Working in pairs, teachers were able to assess these aspects of complexity during the *persuasion* stage before deciding to use the game in the classroom.

- *trialability*: teachers must be able to quickly assess the game, especially in terms of knowledge; the rules should be simple and fair (in the sense that they apply to everyone in the same way). Each teacher was able to assess a number of pre-defined criteria in *knowledge* and *persuasion* stages.

- *observability*: the benefits of using a game in classroom must be clear and visible in terms of student motivation and impact on learning. In the *implementation* stage, students' answer to the questionnaire clearly showed the positive impact on their motivation. A student self-assessment phase and a teacher-led integration phase both helped to highlight student learning that was not obvious from the students' answers to the questionnaire. Observability could be assessed in the *confirmation* stage during the focus group, but also at the beginning of the process in the stages of *knowledge* and *persuasion* by studying various serious games portals and websites. This way one can find field results obtained with a particular game or with serious games in general.

Table 3. Table of tasks performed by teachers and stages of adoption of Rogers

Tasks	**Period**	**Mode**	**Adoption stages**
Design of scenarios using active pedagogies	2010-2011 school year		Knowledge
Exploratory research of serious games related to the class curriculum, list of games that can be exploited in the classroom	September	Individual distance work with wiki	Persuasion
Choice of 4 serious games to test and analyse using a co-designed grid	September-October	Distance work in pairs	Decision
Final choice of 3 games for classroom use (Ecoville, mission PlasTechnologie, Climate Challenge), feedback on the grids, individual testing of the 3 games and feedback	November	Sharing experience and findings via skype meeting	Decision
Preparation of the scenario to implement an existing game, reflection on the implementation of the monitoring of the sequence, choice of pedagogical approach: problem based learning approach	November	Focus group presential	Implementation
Collection of impressions about the question matrix on serious games design proposed by the researchers of the European project GEL	November	Focus group presential	Implementation
Reflection on the success criteria of the sequence (related to learning objectives) Back to the scenario apriori, refining pedagogical phases	December-January	Focus group presential then Distance work in pairs	Implementation
Implementation of the game with classes, questionnaires to students	December-March	Distance work in pairs	Implementation
Analyzing the results of experiments with students, analysis of students' questionnaires	April-May	Focus group presential	Confirmation
Model the learning scenario and propose a learning sequence	June	Distance work in pairs	Confirmation
Interviews (double interview technique)	June - July	Individual interviews	Confirmation

4. Discussion

In our experiment, we could show how the five stages of Rogers translate for adoption of game-based teaching (GBT). This study is not about proving that these five stages occur during the innovation process of adopting GBT, but rather to describe what happens in each stage and how this can be used to accompany the process especially with a group of teachers.
In the stage of *knowledge*, in our case teachers first became familiar with using active pedagogies

based on technologies. It is a cognitive stage. There is a predisposition of individual teachers who feel a need either coming from daily practice (e.g. when teaching complex or domains inaccessible to observation, to motivate inattentive learners, Ney & al. 2012) or just because of GBL awareness (the innovation creates the need). In our case, it is the researchers that suggested to use a game in class. This does not mean that the teachers have decided to adopt games, but that they agreed to collaborate with researchers by the mean of GBL.

In the *persuasion* stage, in our case teachers performed an exploratory search of serious games in their field of teaching and consistent with the curriculum. In this stage, teachers can look for information on GBL and games, anticipate mentally on how they would apply it in their class. It is an affective stage. The teacher forms a favourable or unfavourable attitude towards GBT. An attitude is usually consistent with behaviour and action and the choice to adopt the innovation will follow from a favourable attitude, but not always. However, a teacher that does not build a favourable attitude often wrecks the following implementation stage. Concerning our experienced teachers the *persuasion* stage took place since they are convinced of the value of games whatever the difficulties they still encounter in class.

In the *decision* stage, in our case teachers tested thoroughly different games and filled a co-designed analysis grid. Teachers tried to get familiar with some games by testing them on themselves or with a small group of students. The trial can be only a discussion with colleagues. Then follows the decision to use GBL and may be also a particular game.

In the *implementation* stage, in our case teachers defined a pedagogical scenario that describes the integration of the game in a problem-solving approach. They defined success criteria based on the learning goals and implemented this scenario in their class.

Until now, the process was a mental exercise, now the innovation is put into use and this can lead to behaviour's change in teachers. They face a certain degree of uncertainty inherent in GBL. Depending on individual trait they will live with it or try to remove it. This will in turn give more or less freedom to learners. We note that none of our teachers have mentioned chance and mystery as a motivational factor for using games or use games to favour creativity, imagination or emotionally rich experiences. These are very interesting features of GBL if one look at recent research project calls that seem to be under used by teachers today.

At the implementation stage may occur re-invention (a concept introduced by Rogers), the degree to which the innovation is changed or modify: minor or major reductions or even modifications of the game scenario or the game itself. It is common for teachers in the process of appropriation of an innovation or any kind of resources to re-invent it. A teacher needs to experience it before it gives it to students. This customization allows adapting the innovation to the local school and changing conditions. Innovations that are more complex are more likely to be re-invented (Rogers 2003).

In the last stage of *confirmation*, in our case teachers analyzed their students' answers to questionnaires on motivation and learning, and they redesigned their scenario for the following year taking into account the challenges and improvements proposed in the focus group.

For experienced teachers the *confirmation* phase had taken place before this study as they had been using games regularly for several years. One of them even said: "Since I've been using games, I've introduced humour and contextualized pupils' activities everywhere /.../ it has changed my practice."

The confirmation stage may be used to reduce a dissonant state, i.e. an uncomfortable state of mind generated by the innovation during the implementation stage. Rejection of GBT can come with replacement by another pedagogy or with disenchantment. The latter may be due to a perceived relative advantage compare to previous practice that is not adequate or to misuse of the game or scenario. Another reason of teachers rejecting games may be that they fear of loosing control and time and of the freedom GBL gives to learners.

5. Conclusion

This study tries to provide a better understanding of the process of GBL teacher adoption, from the

first knowledge on games for learning, to forming an attitude towards it; from the decision to adopt it and implement it in class to regular uses. We adopted a dynamic perspective and studied the process over a period of one school year with a group of six teachers. This led us to suggest a number of steps one could take to support teachers over time. This is just a first step towards modelling this adoption process. However, our study is limited since the teachers involved were all collaborating with the research team, and this could generate bias in the findings. The next step would be to follow a wider "independent" teacher population to obtain more balanced and reliable feedback.

Acknowledgements - Thanks to those participating in and collaborating with the Game Enhanced Learning Theme Team (GEL) founded via Stellar Network of Excellence and a special thanks to participating teachers from France and Italy.

Disclaimer - This work was partially supported by the European Network of Excellence STELLAR under the Information and Communication Technologies (ICT) theme of the 7th Framework Program for R&D (FP7). This article does not represent the opinion of the European Community, and the European Community is not responsible for any use that might be made of its content.

References

Berger, J. I. Perceived consequences of adopting the internet into adult literacy and basic education classrooms. Adult Basic Education, 15, 103–121, 2005.

R. Blamire, "Digital Games for Learning: Conclusions and recommendations from the IMAGINE project". European Schoolnet, novembre 2010. http://recursostic.educacion.es/blogs/europa/media/blogs/europa/informes/IMAGINE%20Conclusions%20and%20recommendations%202010-3.pdf (last access october 2013)

Clot, Y. « La compétence en cours d'activité », Education permanente, n° 123, 1995.

De Freitas, S., Earp, J., Ott, M., Kiili, K., Ney, M., Popescu, M., Romero, M., Usart, M., Stanescu, I. Hot Issues in Game Enhanced Learning: The GEL Viewpoint. Procedia CS (PROCEDIA) 15:25-31, 2012.

De Grove, F., Bourgonjon, J., & Van Looy, J. « Digital games in the classroom? A contextual approach to teachers' adoption intention of digital games in formal education ». Computers in Human Behavior, 2012.

Emin V., Pernin J.-P. and Aguirre J.-L. ScenEdit: An Intention-Oriented Authoring Environnment to Design Learning Scenarios. In Wolpers M., Kirschner P., Scheffel M., Lindstaedt S., and Dimitrova V., (Eds) Sustaining TEL: From Innovation to Learning and Practice, vol. 6383 of Lecture Notes in Computer Science, pp. 626-631. Springer Berlin / Heidelberg, 2010.

P. Felicia, "Digital Games in Schools: A handbook for teachers", European Schoolnet, mai 2009. (last access july 2013) http://www.academia.edu/193030/Digital_Games_in_Schools_A_handbook_for_teachers

Garris, R. Ahlers, R. Driskell, J. E. « Games, motivation and learning: A research and practice model ». Simulation & Gaming, 33 (4), 2002, p. 441-467.

Hanghøj, T., & Brund, C. E. « Teacher Roles and Positionings in Relation to Educational Games ». ECGBL 2010 Proceedings. ed. / Bente Meyer. Reading, UK : Academic Publishing Limited, 2010, p. 115-122.

Kebritchi, M. Factors affecting teachers adoption of educational computer games: A case study. British Journal of Educational Technology, 41(2), 256-270, 2010.

Mariais, C., Michau, F. and Pernin, J-P. « The Use of Game Principles in the Design of Learning Role-Playing Game Scenarios », *ECGBL 2010 Proceedings*. ed. / Bente Meyer. Reading, UK : Academic Publishing Limited, October 2010, p. 462-469.

Martins, C. B. M. J., Steil, A. V. & Todesco, J. L. Factors influencing the adoption of the Internet as a teaching tool at foreign language schools. Computers & Education 42, 353-374, 2004.

Ney, M., Emin, V., Earp, J., Paving the Way to Game Based Learning: A Question Matrix for Teacher Reflection. Procedia CS (PROCEDIA) 15:17-24, 2012.

Pivec, P. Game-based learning or game-based teaching? British Educational Communications and Technology Agency (BECTA), corp creator, 2009

ProActive public deliverable "Production of creative game-based learning scenarios: a handbook for teachers", 2010.

Rogers, E. M. Diffusion of innovations - First Ed., Free Press, New York, 1962.

Rogers, E.M. Diffusion of Innovations - Fifth Ed., Free Press, New York, 2003.

Ulicsak M. and Wright M. Games in Education : Serious Games. Futurelab, 2010. http://media.futurelab.org.uk/resources/documents/lit_reviews/Serious-Games_Review.pdf (last access october 2013)

Wastiau, P., Kearney, C., & Van den Berghe, W. How are digital games used in schools? European Schoolnet, 2009. http://games.eun.org/upload/gis-synthesis_report_en.pdf (last access october 2013)