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Nursing homes as a case for assessing Serious Games

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ABSTRACT

Organisations are paying increasing attention to serious games (SGs) in a quest to find solutions to training needs. Evaluation of these software programmes for training purposes marks a crucial stage in serious game commercial development. EHPADs (Etablissements d'Hébergement pour Personnes Agées Dépendantes/ nursing homes for dependent elderly people) suffer from a poor public image. Because staff work long hours, SGs may provide a solution to work training issues. The SG surveyed in this study uses 3D simulation technologies to produce three training situations for the hotel and nursing staff of these establishments hosting dependent elderly people: (1) the admission process of an elderly person to the EHPAD, (2) supervision of a meal and (3) refusal of care by a resident. A qualitative approach is used to evaluate the SG and is based on observations to explain the concepts at work when staff members use the SG. We first carried out several verification phases and then compared our concepts with those from known models so as to build a new model. Our SG is assessed at several different levels.

Keywords: Serious game, evaluation, nursing home, e-learning, training

RÉSUMÉ

L'évaluation des serious games de formation (SG) est une étape cruciale pour garantir le succès de ces logiciels qui suscitent de la part des organisations, un intérêt grandissant. Les Etablissements d'Hébergement pour Personnes Agées Dépendantes (EHPAD) d'une part, pâtissent d'un déficit d'image et d'autre part, leurs personnels ont un rythme de travail élevé. Les SG peuvent alors représenter une solution intéressante de formation. Le SG étudié utilise les technologies de la simulation 3D pour trois situations de formation à destination des personnels hôteliers et soignants des EHPAD : (1) l'accueil du résident, (2) la prise de repas et (3) le refus de soins. L'évaluation du SG est basée sur une approche qualitative permettant d'appréhender, par l'observation, les modalités de l'utilisation du serious game par les personnels et d'opérer une comparaison entre ce SG et les facteurs rapportés par la littérature sur les SG.

Mots clés : Serious game, évaluation, EHPAD, e-learning, formation

INTRODUCTION

Video games are playing an ever increasing cultural role in society. This technology and its varied applications have developed rapidly in recent years due to the maturing of both hard and soft technology, broadband Internet, and better integration between the Internet and telephony equipment.

Serious Games (SGs) differ from video games as they aim to achieve pedagogical purposes and meet serious end goals: *"Applying games and simulation technology to non-entertainment domains results in serious games"* (Zyda, 2005, p. 30). The "serious game" has been presented in the following terms: "the oxymoron of Serious Game unites the seriousness of thought and the problems that require it with the experiential and emotional freedom of active play" (Abt, 1970, p. 11). In the rest of this paper, the term "serious game" will refer more particularly to games that teach specific skills while complying with the following definition: "serious games are (digital) games used for purposes other than mere entertainment […]. Serious games are considered as Game-based Learning (GBL) applications" (Jercic et al., 2012, p. 2).

SGs work best with digital natives who are familiar with video games. They involve high development costs partly due to the multidisciplinary teams brought together to conceive them, which include subject matter/content experts, stakeholders, game developers, instructional designers, social scientists, usability practitioners, game designers, artists, modellers, and engineers (Raybourn, 2007).

However, when a critical mass of users is achieved, SGs' running costs prove less expensive than more traditional training where materials and resources are required (Kirriemuir & McFarlane, 2004). It must also be noted that although large sums are spent on vocational training (in France annual training expenditures equal €31.3bn or 1.6% of the GDP), the results are limited (Cadin et al., 2012). Given this situation, it seems likely that organizations wishing to promote vocational education will turn to SGs, especially when physical participation in training activities is in conflict with staff management issues due to the hiring of new staff or employee turnover.

This is the case for nursing homes where it is difficult to recruit qualified staff (Bouzou, 2010). The ageing population is a worldwide phenomenon that is particularly marked in many countries. While people aged 65 and over amounted to 6% of China's total population in 2006, they will account for 22% of the Chinese population by 2030. Twelve percent of the US population was aged 65 and older in 2007, yet the figure will reach over 20% in 2025 (Walker, 2007). Currently in Italy, 10.6 million people are 65 years of age and older, namely 19% of the total population. INSEE (Institut National de la Statistique et des Etudes Economiques/National Institute for Statistics and Economic Studies) forecasts that the number of French people aged 65 and over will increase from 16% in 2000 to 29% in 2050. All these examples clearly show that a significant number of nursing homes will have to be built if the situation is to be addressed. Moreover, as the popula-

tion is tending to live longer, and because individuals are postponing the decision to move to skilled care establishments until later in life than did previous generations, elderly people are often care dependent when they finally decide to reside in a skilled nursing facility. A survey by the Department for Forecasts and Statistics (DREES) of the French Ministry of Health and Social Affairs shows that nursing home residents are becoming increasingly more dependent. Traditional nursing homes must gradually be replaced by establishments for care-dependent elderly people. These are known as EHPAD in France, and they are currently in very short supply (Godet & Mousli, 2008). Eighty-five percent of current EHPAD residents suffer from loss of autonomy, and 51% of these individuals are highly care dependent. The need for more skilled establishments is compounded by the shortage of sufficiently well-trained staff. Geriatric care posts are highly demanding because they involve working with people in chronic pain and imply confronting illness, death and handicaps on a regular basis, contributing to staff fatigue and burnout (Da Cruz, 2009). This in turn results in high staff absenteeism and turnover (Connangle & Vercauteren, 2004; Vion, 2011). There is a link between turnover and quality, as high staff turnover is associated with diminished quality and results in higher health coverage costs (Andrieu, 2009). A lack of appropriate training and skills is a leading cause for ill-treatment of elderly nursing home residents and is widely recognized by those working in the sector (Da Cruz, 2009; Daovannary, 2011). Promoting and implementing improved training is one of the factors that can thus prevent ill-treatment (Chassat-Philippe, 2010). All of these elements prompted an interest for SGs in the nursing home sector. To study this movement, in this paper we address two research questions. First, to what extent can SGs become efficient and relevant training tools for EHPADs? Second, how can we evaluate the impact of SGs within EHPADs?

The remainder of the paper is structured as follows. Section 2 is a review of the literature evaluating SGs (2). Section 3 describes our research along with the evaluation framework. Section 4, analyses and evaluates the results of our study of SGs in this context. Finally we highlight the paper's contributions and limits and point to avenues for further research.

I. REVIEW OF THE LITERATURE EVALUATING SGS

We shall first successively describe the evaluation methods (I.1.) and then the factors retained for designing serious games (I.2.). The assessment activity aims to guide the choice of projects or to analyse a system's value. It can deal with a SG's potential and be carried out a priori, namely as an ex-ante assessment or be judged on results a posteriori, namely as an ex-post assessment. This evaluation can also be considered both as a process and as a result.

I.1. Four generations of evaluation

Assessment methods have changed over time and have been linked with

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different streams of thought (Guba & Lincoln, 1989; Klecun & Cornford, 2005). Guba and Lincoln identified four different generations in the assessment of social systems that can be applied to Information Systems (IS): measurement, description, judgement and social process generation (Marciniak & Rowe, 2009).

I.1.1. Measurement

The first generation represents that of "measurement" where the evaluator is a technician who knows about measurements and applies them. For example, for a software program, the amount of code, its complexity, its response time and the number of errors become measurements that permit evaluation of the quality of the software program. By drawing a comparison with a given standard, this metric orientation allows one to distinguish between good and bad projects, and thus it becomes possible to identify and capitalize on good practices and pass them on.

Serious games can be measured at two levels: the multimedia quality and the training content quality. For example Nadolski et al. (2008) propose a list of questions similar to a standard framework, while Jercic et al. (2012) set up a psychophysiological measure of stress based on heart rate.

I.1.2. Description

The second generation is that of "description" where the measurement is used as the instrument to identify how expected results can be obtained from the project's description. The project is

"an approach characterized by the description of patterns of strength and weakness with respect to certain stated objectives" (Guba & Lincoln, 1989, p. 28). The evaluator's role is that of an analyst who describes (a system's or project's) objectives, strengths and weaknesses with regard to stated objectives. Evaluations using TAM (Davis et al., 1989), UTAUT (Venkatesh et al., 2003) or ISSM (Delone & McLean, 2003) models can be associated with the second generation, as they include different concepts and their relations. For example, the TAM model connects these criteria by applying them to the various measurements for each variable in the system. This connecting process is a description that explains the links between ease of use, perceived relevance and the attitude towards the use and the intention of using the measure.

For example, in Kelly et al.'s (2007) description evaluation, the authors describe the strength and weakness of a serious game's design project. For Foster and Hopkins (2011) the evaluation of training content is performed in a descriptive survey.

I.1.3. Judgement

"Judgement" makes up the third generation. It criticizes the neutrality of the previous evaluations' descriptions: "the evaluation supplies facts, but the facts mean different things to persons holding different social values and with different interests at stake" (Cronbach, 1990, p. 28-29). An unbiased judgement thus becomes necessary. To fulfil this task, the evaluator uses standards, models and referentials, and passes

judgement on objectives, on ways and means, and on processes. With this method "both description and judgement are essential — in fact, they are two basic acts of evaluation" (R. Stake in Guba & Lincoln, 1989, p. 30). Regarding SGs, Rouse (2005) explained the use of measures as a basis for judging simulation scenarios. Ritterfeld et al. (2009) described and judged the educational impact of a SG according to different modalities.

I.1.4. Social process

"The constructivist generation" is the fourth generation of evaluation that takes into account the highly social character of the evaluation process. This fourth generation integrates the elements from the previous three generations and compensates for their shortcomings. It does so by first taking the stakeholders' claims into account and, second, circulating the collected information to shed light on the different evaluation viewpoints. This generation allows for the autonomization (self-determination) and definition of context (Huebner & Betts, 1999). In a process akin to that of action research, the evaluator takes an active part in the evaluation process alongside the stakeholders (hermeneutic cycles) so the evaluator becomes "a collaborator in the process rather than a controller" (Guba & Lincoln in Huebner & Betts, 1999, p. 343). The ETHICS method (Mumford, 1995) is similar to this generation of evaluation as it reconciles the ICT (Information and Communication Technology) operator's point of view with that of the user through a socio-technical approach and a negoti-

ation process. It is a method of participatory design with the goal of moving towards reaching consensus among stakeholders.

The move from one generation to the next is cumulative, so each new generation capitalizes on the knowledge acquired by previous generations and attempts to bridge the shortcomings of the former generation. The social process is currently used less than the other evaluation methods, partly because its implementation is demanding in terms of resources and time. This also explains why examples for this generation are not found in the SG field.

I.2. Success factors of SGs

The review of the literature on SG research identified three categories of factors determining a Serious Game's success (I.2.1.). The factors depend on the organizational context (I.2.2.) in which the serious game is inserted, on the SG user's personal characteristics (I.2.3.) and the SG's quality level (I.2.4.).

I.2.1. Success criteria for SGs

The literature review reveals three effects of SGs, namely on learning, staff skills and user satisfaction with these tools.

First, SGs can enhance learning (Kirriemuir & McFarlane, 2004; Nadolski et al., 2008; Ritterfeld et al., 2009) and staff skills in the field of training. This effect has been noted in banks (Allal-Cherif & Bajard, 2011), marketing, trader stress management (Jercic et al.,

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2012), and military strategy (Ranchhod & Loukis, 2012). This can be explained by the high level of control learners exert on their own learning (Bell et al., 2008). Where improving staff skills makes up a SGs' major objectives, the TAM model's "perceived utility" can also become one of the SGs' success criteria.

Second, team work and cooperation can be encouraged thanks to SGs (Allal-Cherif & Bajard, 2011) for example, by creating a dynamic around the game and how the system is being used. A challenging environment among players can also arise (Lang et al., 2009).

Third, SG user satisfaction makes up another success criterion (Kelly et al., 2007; Ranchhod & Loukis, 2012; Raybourn, 2007). The ISSM model takes this user satisfaction criterion into account (Delone & McLean, 2003; Michel & Cocula, 2014).

I.2.2. Organizational contextual factors

The particular nature of SGs as learning tools with visuals, narratives, and multimedia content requires a multidisciplinary team of experts including multimedia specialists, scriptwriters and design artists in addition to other skill sets (Nadolski et al., 2008; Raybourn, 2007; Thompson et al., 2010). Team work among experts in different fields is often challenging because of communication problems, as highlighted by Howell (2005, p.106): "Interdisciplinary teams often do not communicate well, even if they do collaborate on games".

"Social influence" is a factor that considers the extent to which consumers perceive as important that others believe they should use a particular technology. The factor "facilitating conditions" refers to consumers' perceptions of the resources and support available to perform a behaviour — as described by the UTAUT model (Venkatesh et al., 2003; Bourdon & Hollet-Haudebert, 2009). These factors can be deemed akin to the organizational contextual factor because they represent the collective influence on intention of use and on how ICT tools are being used.

I.2.3. SG users' individual factors

The review of the literature also focuses on some SG user individual factors, such as previous experience (like job training), age or more precisely, if the user belongs to the digital native generation.

Since video games have become a major part of the general culture and target young people (Alvarez & Djaouti, 2008; Thompson et al., 2010), serious games often target digital natives (Allal-Cherif & Bajard, 2011; Zyda, 2005) as SGs seem best suited for them. However, assuming that a whole generation of people has the same expectations or the same practices must be greeted with caution (Kirriemuir & McFarlane, 2004).

Using video games as job training tools requires taking into account the learners' other individual factors, such as how they define themselves in their environment (Cannon-Bowers & Bowers, 2007), or how much they already know about job training (Ritterfeld et al., 2009).

I.2.4. *"Product" factor and SG quality*

The analysis shows that some SG factors also concern both the game with its properties (immersion, interactivity, flow, etc.) and the serious end goals that they pursue (learning and training).

The game contains several properties of social presence and visualization (Ives & Junglas, 2008), but also creates an environment of immersion and interactivity (Bell et al., 2008; Jercic et al., 2012; Ritterfeld et al., 2009) which can be activated through feedback by a traditional visual, sound or ITC interface. These SG properties contribute to creating the sense of flow described as an "optimal experience" (Csikszentmihalyi, 2008; Kirriemuir & McFarlane, 2004). This enjoyment of the game, known as flow, has to be coupled with a serious end goal and therefore bring out the intended learning and training content of SGs (Kelly et al., 2007; Nadolski et al., 2008; Zyda, 2005). These product's specific qualities take part both in "the systems quality" as with the ISSM model (Delone & McLean, 2003) and in "the systems' ease of use" as suggested in the TAM model (Davis et al., 1989).

SGs have been used in a large variety of fields, including healthcare (Baranowski et al., 2008; Kelly et al., 2007; Thompson et al., 2010), the military (Cane et al., 2004; Smith, 2010; Zyda, 2005, 2007), IS management (Lang et al., 2009; Nadolski et al., 2008), finance (Jercic et al., 2012), and marketing (Ranchhod & Loukis, 2012). These various fields highlight SG potential, but also the importance

of scriptwriting (Howell, 2005; Raybourn, 2007). This represents a content quality akin to "information quality" in the ISSM model (Delone & McLean, 2003).

II. EHPAD SG RESEARCH: CONTEXT AND EVALUATION SETUP

We shall now describe the research context for the EHPAD in Echirolles and present the call for "serious gaming" projects. We will then describe the evaluation method that was adopted.

II.1. The context

A call for "Serious Gaming" projects was launched in June 2009 by the General Directorate for Competitiveness, Industry and Services (DGCIS) within the Ministry of Economy. This call for innovative projects aimed to develop professional tools based on techniques from video games and had to integrate business partners, government agencies and research laboratories. The project that was submitted and selected by the DGCIS brought together the following partners: the town hall and nursing home in Échirolles, France, the University Paris-Ouest and the Daesign Company, specialized in the development of SGs. This call for project had a pivotal role in providing a framework for development. Funding ended in June, 2011.

We first present the research field (II.1.1.), the SG's content (II.1.2.) and the characteristics of the development project (II.2.3.).

II.1.1. Echirolles' EHPAD

Champs Fleuri is an EHPAD in Echirolles that was the site of the research. This public EHPAD is part of the town's CCAS (Centre Communal d'Action Sociale/ Welfare Center) and has 64 residents, 52 staff including one coordinating Medical Doctor, one psychologist, a head nurse, a catering manager, three nurses, about 20 hotel staff, and roughly 20 nursing assistants. The establishment can be classified as a fairly large EHPAD and brings together several categories of professionals relating to care and cure. In order to provide continuity of service the teams work staggered shifts.

Hotel staff and nursing assistants are the target of the SG. Given their intensive and specific work patterns, training these staff groups is challenging. Moreover, due to high staff turnover, traditional training methods do not succeed in maintaining quality processes.

II.1.2. Three selected scenarios

Three themes were selected as the basis for the SG's three scenarios, namely an elderly person's admission to the EHPAD, meal supervision and health care refusal by a resident. The following reasons make the three selected themes particularly interesting:

First, an elderly person's admission to the EHPAD conditions the continuation of the rest of their stay in the healthcare establishment and the staff are likely to say that "when admission goes well, so does the rest". It is therefore essential to build trust in the relationship with the elderly person from the start, to meet their needs and calm their fears.

Second, meals are moments highly valued by this elderly population, as meal times punctuate the day's rhythm. They are also the time when all residents and staff can interact with each other. Meal supervision is a demanding task for the staff and meals occur four times a day, thus giving staff the opportunity to check on resident comfort levels.

Third, refusal of care is stressful for healthcare workers. Management of this issue is complex, namely how far can residents be pushed into accepting treatment when they do not wish to do so? With adequate communication skills and by giving explanations or promoting dialogue, the staff can convince residents that accepting healthcare is necessary, even though accepting treatment may cause unease or even discomfort.

The three scenarios cover a large part of the work done by the staff targeted by the SG.

II.1.3. Project development characteristics of the SG

The EHPAD's Director, the coordinating Medical Doctor, Echirolles' CCAS managers, the head nurse and the researcher all actively participated in the SG project. The project's life cycle used repeated convergence and prototyping to produce a final version (Marciniak & Rowe, 2009). The following cycle was set up while producing each scenario: first Daesign, a company specialised in SG implementation, suggested a synopsis that the work

team read over, modified and validated. Second, Daesign supplied a scenario template which the work team completed and amended. Then, after several exchanges between Daesign and the work team, prototyping was performed and corrections were made through the successive iterative method. Finally, after the work team had validated the scenarios, Daesign recompiled them so that technical constraints were taken into account and a final version for the SG was proposed.

All the staff attended formal information meetings at the project launch, after the completion of each scenario and at the close of the project.

Table 1 shows all the meetings organised within the project's scope.

The technology used to create the SG is based on real-time 3D for scenario 1 and on pre-calculated 3D for scenarios 2 and 3. The EHPAD provided an equipped room for SG staff meetings. Furthermore, the logbook maintained by the researcher during the course of the project significantly contributed to the progress of the project.

II.2. Methodology

The methodology will be explained as follows: the generation of evaluation implemented in our research (II.2.1.), data collection (II.2.2.), data processing (II.2.3.), and data analysis (II.2.4.).

II.2.1. Implemented generation of evaluation

The SG project united many different types of stakeholders (medical doctors, job experts, nurses, developers, 3D graphic designers, etc.). Use of the successive iterative method was required because of unresolved claims that caused tension among the different types of stakeholders and provoked inter-group conflict. The EHPAD work groups (medical experts and EHPAD workers) and the project manager (technical constraints / cost) had to be harmonized by reaching consensus. The evaluation became a process based on hermeneutic cycles interpreting the observations, and on a process taking into account the claims of the different stakeholders. The evaluation process was, therefore, more like that of the fourth generation. However, since the targeted staff did not take part in the different conception steps or SG content validation, the final evaluation in which they participated resembles that of the third generation, namely judgment.

Type of meeting	Number of meetings
Conception meetings	9 (3/scenario)
Scenario validation meetings	3
Staff project information meetings	4

Table 1: EHPAD SG meetings

II.2.2. Data collection

The data was collected by observation. Thanks to this collection method, phenomena can be apprehended in context and be described, while empirical data can be provided to shed new light on the processes, events, and interactions. The observation was set up for varied issues in management sciences, e.g., managers' daily activities (Mintzberg, 1984) or those of maintenance technicians (Orr, 1996).

Two arguments justify the choice of observation as a collection method, rather than other forms of data gathering such as experimentation, interview or questionnaire. Given the low training level of the targeted staff, we observed that the interview was a poor data collection tool, because the staff members hardly said anything. Above all, they were positioned at the bottom of the hierarchical scale, and as a result, the staff members systematically sought the researcher's approval. Our observations were made under the status of "observer participant", meaning that the position of the researcher is explicit, watching people at work (Junker in Groleau, 2003), and in their interaction with a serious game scenario. Observations were made from January to November 2011 through a two-session protocol for 36 people, i.e., 72 observations per scenario and 216 observations for the SG (see Table 2). The time allocated to SG use was 6 hours (six one-hour sessions per person) which represents a total of between 138 and 140 hours of observation use for the EHPAD.

The profiles (gender, age, job seniority, seniority in the EHPAD) of the people who experimented with the SG are described in Table 3.

N°	Name of scenario	Number of observations
1	Elderly person's admission to the EHPAD	36 people x 2 sessions =72 observations
2	Meal supervision	36 people x 2 sessions =72 observations
3	Healthcare refusal	36 people x 2 sessions =72 observations
Total		**216 observations**

Table 2: Summary of observations

Gender	Male	Female	Age	Average (year)	Standard deviation	
	5	31		41	12,4	
Occupation	Hotel staff	Nursing staff	Job Seniority	Average (year)	Standard deviation	
	20	16		9	7,9	
Seniority	< 1 year	From 1 to 3 years	> 3 years	Education level	< high school	high school	> high school
	5	7	24		21	5	10

Table 3: Staff description of the 36 individuals involved

II.2.3. Data processing

The observations were analysed using the methods recommended by Miles and Huberman (1994). This three-step analysis process aims (1) to condense the data (encoding/ categorization), (2) present the data, and (3) formulate and verify the conclusions.

Coding was done iteratively through: (1) pre-established coding — the codes were determined a priori from a selective analysis of the literature and were used during coding, and (2) emerging coding became evident after several readings and analyses (Miles & Huberman, 1994). Final coding was a set of inductive and deductive coding resulting from several engagements with the research material. While the data was being condensed, the codes were revised, deleted or merged.

When presenting the data in a second step, we analysed the recurrences by identifying "repeatable regularities" (Kaplan in Miles & Huberman, 1994, p. 69). Initial counting of occurrences allowed us to delete the least representative codes and to evaluate the strength of a given category in our observations. We then compared our encoding with Delone and McLean's ISSM model and set up a contiguity matrix. Finally, we carried out a causality analysis (an if-then test) to confirm the existence of links and establish their orientation.

II.2.4. Data analysis

In a first phase we established an initial list of the codes found in the literature, mainly from the Delone and McLean ISSM model (Delone & McLean, 2003; Petter et al., 2008), de-tailed in appendix A, from the TAM model (Davis et al., 1989; Davis, 1989), and using the UTAUT model (Venkatesh et al., 2003). Note that the variable "service quality" proposed in ISSM is unnecessary in the context of our research because we are not dealing with the maintenance or evolution of the SG. The whole set of categories was enhanced by the discovery of the new categories issuing from our observations. The new inductive categories were added to those derived from the literature to complete the analysis. The new categories appeared in a more or less marked fashion in our observations and we calculated the number of occurrences for the category against the total number of occurrences, which we call the category's weight. Then we ranked the category importance by number of occurrences. Finally, we removed the categories showing no occurrences. As pointed out by Miles and Huberman *"there are no fixed rules for constructing a matrix [...]. Think matrix, and invent formats that will serve you best"* (Miles & Huberman, 1994, p. 240).

After excluding nine categories of low occurrences, shaded in appendix B and detailed by scenario in appendix C, we combined the categories "Sense of Learning" and "Perceived Usefulness" which are semantically very close. We then grouped the categories by families: (1) context, (2) manner of being (state and attitude) and (3) relation to the SG in terms of what the staff think of it and how they feel about using it. The context was the environment of the SG through the unfavourable conditions that generate a "stressful experience". "Manner of

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being" gathers attitudinal categories with regard to the SG. Finally "relation to the SG" includes categories for the SG product, namely multimedia quality and formative content. Table 4 presents the encoding of the categories.

Context	Description		Number of occurrences	Deductive Inductive
Unfavourable conditions	Negative effects due to the context of SG use		46	IND
State of being				
Flow	Specific psychological state mainly due to an intense focus on the ongoing task, loss of self-awareness, loss of time sense		122	IND
Attitude	Positive	Positive or negative state of being relative to SG use	Positive 68	DED
	Negative		Negative 14	DED
Stressful experience	Stress experienced when using the SG		30	IND
Reading difficulty	Difficulty & hindrance in using the SG because of reading shortcomings		16	IND
Relation to the SG				
Experience of pleasant use	Staff felt it was pleasant to use		95	DED
Perceived usefulness	Feeling that the serious game is useful, it promotes learning (calling into question, change in behaviour…)		88	DED
Intention to use SG again	Willingness to use the game again		75	IND
Ease of use	SG's ease of use perceived by staff members		62	DED
Difficulty of use	SG's difficulty of use perceived by staff members		14	DED
Multimedia quality	Sound & graphic quality perceived as high when using the SG		19	DED
Need for improved functionality	Desire for an altered or improved function		5	IND
Comparison between virtual/real world	Comparison by staff members between SG virtual world and reality		25	IND
Previously acquired knowledge	Staff feel they already perfectly master the activity		12	IND
Scenario Quality	SG quality as perceived by users (conformity & credibility of job situations & dialogues)		22	DED
Disagreement with the scenario	Disagreement expressed about the scenario (story)		18	DED
Different approaches to the situations presented in the SG	Divergent perceptions in the context of interactivity (other than "right or wrong")		43	IND

Table 4: Families by category and definitions

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We then proceeded to the consolidation of the categories through a qualitative analysis of the material.

III. RESULTS AND DISCUSSION

We now detail the results concerning each scenario (III.1), the overall result for the EHPAD's SG (III.2), and the comparative analysis of the results for the EHPAD's SG with those from the literature (III.3).

III.1. Data on the SG scenarios

In this section we present the data on the three scenarios: (III.1.1) the first scenario about an elderly person's admission to the EHPAD, (III.1.2) the second scenario about meal supervision and (III.1.3) the third scenario about health care refusal by a resident.

III.1.1. First scenario -
An elderly person's admission
to the EHPAD

The staff discovered the interface (sounds and graphics) for the first time and the general operation of the game through this scenario. That explains the many comments on the multimedia quality and the scenario's quality: "It is well done, the voices are well rendered", "I think the presentations are well done, for hotel staff and nursing assistants, it was good".

Perceived usefulness is strongly expressed in the comments: "We are more interested in the SG than in formal training," "for a nursing assistant, the content seems very interesting in order to question the current prac-

tices." The usefulness is linked to the "video game" training format, and the possibility of calling practices into question and changing them. This confirms the strength of the scenario's success factor in relation to the learning success criteria from the literature. Some staff felt they already optimized the activity proposed in Scenario 1: "frankly I liked it, very professional: it reassures elderly people, but that's what we already do."

The intention to reuse this scenario appeared to be very low, less than for the other two scenarios (three times less than for the second scenario and five times less than for the third). A second point is that the final synthesis of the scenario was sometimes seen as stressful. During these observation sessions we noted the importance of user satisfaction when using the scenario.

III.1.2. Second scenario -
Meal supervision

The staff liked the scenario, but the number of observations in the category "different approaches for the situations presented in the SG" was lower for scenario 2 (7 observations) than for scenario 1 (16 observations). While the number of observations in the category "disagree with the scenario" was higher for scenario 2 (11 observations) than for scenario 1 (4 comments), fewer functional improvements were proposed by the staff for the second scenario.

The multimedia and scenario quality in these observations also elicited fewer reactions (16 and 13 observa-

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tions for scenario 1, and 1 and 5 observations for scenario 2). The impact of the effect of discovery when using the first scenario faded away because the interface and method of use were generally known by the staff, and because as they gradually became accustomed to the interface and its operation, they mentioned it less often.

There was a low frequency of staff reporting either perceived usefulness or learning acquired through this scenario's SG. In scenario 2, the staff members reported less frequently that they did not already optimally carry out the tasks (relative to scenario 1). Note that paradoxically, the intention to reuse scenario 2 was stronger: "she asked to play scenario 2 again," "one staff member asked if he could have his own demo of the game to train with", "a hotel staff member said she would use it because when she loses, she wants to try again." She added, "that would serve me well because I have no formal training." Note also that these intentions are of three types: immediate reuse, reuse at the nursing home later, or reuse at home. For some staff members this type of training is of great value, they want to continue to use the video at home to improve their skills. Scenario 1, the elderly person's admission to the EHPAD, is a "ritualized" theme because this admission is done only once per resident, often with family members and this is performed roughly fifteen times per year. This activity is more symbolic and requires preparation and major adaptation. In contrast, meals and care are recurring activities that happen many times every day, usually without the presence of the family.

III.1.3. Third scenario - refusal of health care by a resident

Scenario 3 was also greatly enjoyed by staff members, including the hotel staff. Although the latter are not in charge of administering care they may encouunter refusals from the elderly residents. In scenario 3, the hotel staff saw the opportunity to improve their management of care refusal by an elderly person and the opportunity to learn about work done by other staff members: for the hotel staff, the scenario provided new solutions and ideas to deal with refusal: "it shows to us everything in detail, it is super, super, I would like to continue to play, thank you very much." After using this scenario several times, some hotel staff felt the assistant nurses' role was particularly highlighted and the staff feedback was "that it teaches them about the work of nursing assistants, but it should also show the reverse (other staff roles)." With this scenario, nursing assistants understood the meaning of challenging their practices, they learned how to ask questions and to find new solutions. A nursing assistant said he agreed with the SG's responses and added that he understood why he had lost in the game.

Differences in answers and perceptions emerged during the dialogue: "It's great, but sometimes it seems that all three choices can work." These differences also have their roots in the comparison between real world and the context of the game: "We can meet the old lady, but if you have a lot of work, how can you address the situation?" Another nursing assistant said that the SG did not provide the re-

sponses she would have applied in real life. Finally one hotel staff said, "I find it better than the second [scenario], the situation is more real." This shows the existence of a projection on to reality: they wonder how they can reuse the contributions of the serious games' situations, and they try to evaluate its similarities with real situations.The analysis of the results for the EHPAD's SG further explains the categories and the relations between the different concepts in action.

III.2. Results for the EHPAD's SG

Establishing the categories and the families of categories represents a first result that is consolidated with the material collected in the context which includes unfavourable conditions — "they were beeped during the game" or "one of the nursing assistants had to hurry up a bit because she had to start her work shift and take part in the meeting to share resident status information." These are symptoms of a lack of spare time, and show how intrusive field constraints may be when the SG is being used.

Generally speaking, the video game format was greatly appreciated (pleasant use experience). Staff members seemed to be interested in the scenarios, although they wished they could have supplied other answers, which is another way of showing interest (through the observed flow and perceived usefulness). Few staff members refused to call themselves into question, or to challenge their daily practices in relation to the SG, and it must be noted that calling oneself into question in front of a third person is diffi-

cult. The contextual impact is particularly strong, much stronger, in fact, than we originally expected. The stress reaction engendered by using the SG as a training tool was not nearly as evident prior to our observations. We were able to reconnect each category of coding family to real life situations thanks to our observations.We linked our observations to ISSM models (Delone & McLean, 2003).

We then ran a follow up analysis to explore the order in which the families that make up the concepts appeared. The analysis aimed to prove the existence of some contiguity influence among the concepts modelled above. It must be noted that when contiguity does exist, it only brings out a plausible mechanism linking the concepts (Miles & Huberman, 1994).

Compared to the chart considered previously, we observe a weak link between certain concepts, namely "unfavourable conditions", "reading shortcomings", "need for improved functionality", "previously acquired knowledge". We notice that owing to the model of the links (Figure 1) that the "disagreement with the scenario" concept shows no strong link. We suggest, therefore, that it should be merged with the "divergent understanding of answers" concept by slightly extending the concept's meaning. Moreover, the model shows the existence of strong links between the different concepts.

We then ran a causality analysis to orientate our chart. We used "if-then" tests to build statements (Miles & Huberman, 1994). To that end we confront the link analysis — carried out on
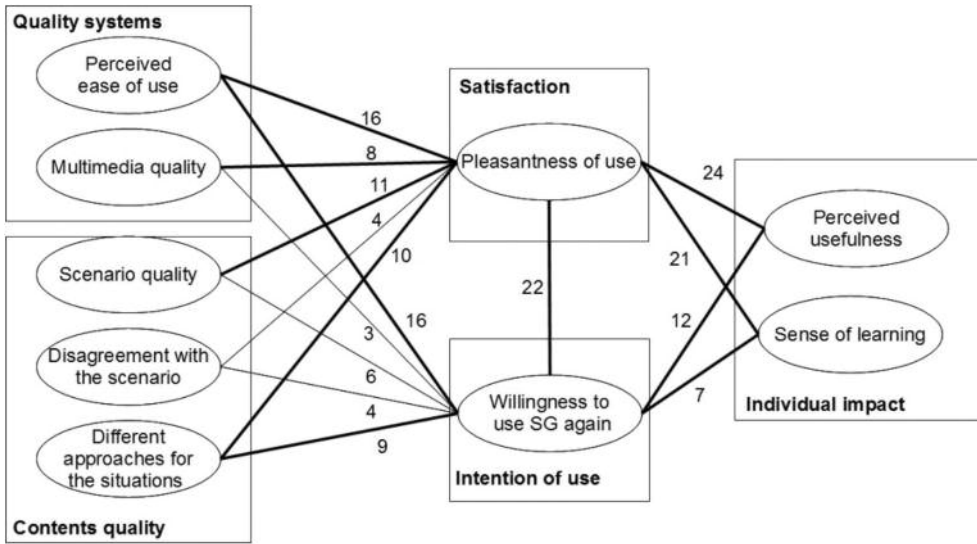
Links in number of concomitant categories

Figure 1: Links between observations and ISSM model

the basis of counting occurrences — with the observations.

As Miles and Huberman note, after such a test, "we are a long way from a *law* about the relation between the two considered elements, (…) but we know more than we did, and can take some next analytic steps" (Miles & Huberman, 1994, p. 271). The analysis allowed us to identify certain elements that lead toward understanding the relation. From the original orientation of the link as explained by Delone and McLean and the contiguity analysis, we suggest the following statements:

Statement 1: IF Systems quality THEN Intention of use,

Statement 2: IF Systems quality THEN Satisfaction,

Statement 3: IF Content quality THEN Intention of use,

Statement 4: IF Content quality THEN Satisfaction.

The four statements concern content or systems quality and how they relate to intention of use or satisfaction. After doing several "if-then" tests, it appears quality ranks ahead of satisfaction and intention of use as regards the systems quality: "she told me she found the SG very well explained [...] she asked whether she will be able to play the game at home". The same type of response structure recurs many times during the observations.

Two types of behaviour are to be noted: either the staff members agree with the scenario (contents) and they ask to play the game again to improve their skills, or their perceptions differ from those in the scenario, so they wish to play it again to get a better understanding of it.

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The same goes for systems quality as staff members analyse the game first: "it's as if we shared their lives" or they assess the game's quality in terms of how much work went into it: "it's a hell of a lot of work!" Ease of use also plays a part in the relation, since when the system is easy to use, staff will use the game again without asking for permission to do so.

One notes that the same pecking order applies to scenario quality, since the staff member first assessed the scenario's quality and then asked to use it again. For example, the nursing assistant acknowledged that she agreed with the answers given by the SG, she understood why she lost and finally, she asked if she could play again later. The same applies for satisfaction where a male staff member said: "all in all, when it comes to meal supervision, there's no difference whether the meals are taken in the common room or in a resident's bedroom. This employee was very happy, although he may have had mixed feelings at first, he did enjoy the game in the end". We suggest the following statements:

Statement 5: IF Satisfaction THEN Intention of use,

Statement 6: IF Intention of use THEN Individual impact,

Statement 7: IF Satisfaction THEN Individual impact.

From our observations it appears that satisfaction induces intention of use rather than the opposite. For instance "the second hotel staff member managed to complete the game, so she is very happy and would like to play

the game again". This will have to be confirmed when we later move on to the quantitative analysis on use in addition to that on intention of use.

Statements 6 and 7 recur regularly in the observations. The link between "intention of use" and "individual impact" is perceived through the "sense of making actual progress" and "perceived usefulness". The following is a relevant example to illustrate the relation: "The staff member tells me she wishes she could take the game home and play it again after she lost a game. She adds: "it would be very useful for me as I never had any form of professional training at all". The play-again learning factor unfolds throughout the text because staff members sometimes timidly ask to take the game home for no particular reason. Satisfaction also plays a part in the individual impact of the SG.

The statements are therefore in accordance with the ISSM model (Delone & McLean, 2003) as regards link orientation.

III.3. Comparative analysis of the EHPAD's SG results with results from the literature

The research consisted of taking part in the SG's design and development, and in conducting a qualitative evaluation through the observation of SG users. We shall now compare the factors identified in the review of the literature concerning SGs with those we observed during our research on the SG for the EHPAD staff.

The success criteria for the EHPAD's SG were identified by observing how

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the staff used the tool. The criteria concerning training and learning contents were identified in terms of how the staff perceived the SG's usefulness: "the content seems interesting enough so as to call the practices involved into question". The enjoyment derived from the game was identified by staff member experience using the game and the satisfaction identified by both the positive attitudes adopted by a majority of the staff and their intention to use the application again: "it goes into full detail, it's super hyper, I wish I could keep playing it, thank you very much" or also "I must start again, I want to go the whole way..."

Organizational factors were revealed in the research logbook that we maintained throughout the duration of the project. They deal with the need to draw on multidisciplinary teams, with the difficulties, communication among these teams, and the time consumed by this mode of functioning. We also took note of the SG's cost. Finally, we observed some conditions that discourage use of the SG and relate to the organizational context like "they were beeped while the game was in progress". These unfavourable conditions were not identified in the literature on Serious Games, so they may be linked to the organization's local context as indicated in research on e-learning. These studies highlight the impact of physical, social and time constraints that hinder on-site training (Bernardin, 2007; Vasquez Bronfman, 2004).

The individual factors from the literature were partly identified in our research, e.g., (1) knowledge previously acquired which was included in our research logbook during setup and (2) the state of flow: "The nursing assistant is focused, the silence is imposing". The SG's particular orientation towards digital natives was not identified. Satisfaction was indeed high among the staff although their average age was 41, which does not prove that these tools are better suited to young staff members. By contrast, a stressful factor unidentified in the SG literature was revealed during our research, for example, "will the tool be used to grade us?" or "she (the staff member) is afraid of losing".

The factors from the literature relating to the SG's quality identified in our research dealt with scenario content: "they think that in the software program the bedroom looks beautiful" or "it's well designed, the voices are well rendered".

Table 5 presents a comparative synthesis of the different factors.

Similarities between e-learning and serious games such as enabling learning in different areas (Alavi, 2002; Spallanzani & Filippi 2004; Zhang et al., 2004) give the learner more control over certain aspects of training by the choice of modules and training rhythm (Piccoli et al., 2001), and provide the ability to implement the formated content based on the relevant learning model (Leidner & Jarvenpaa, 1995; Vasquez Bronfman, 2004). These similarities indicate that serious games are not isolated artifacts, but a kind of evolved e-learning, as we have shown by a detailed comparison in another publication (Cohard, 2013).

Factors from the literature	Key authors	Factors from our own research work
SG success criteria		
Training, learning contents	Kirriemuir & McFarlane, 2004; Nadolski et al., 2008; Ritterfeld et al., 2009	Perceived usefulness, sense of learning as revealed in the observations
Enjoyment of the game	Zyda, 2005, Alvarez, 2008	Pleasant/ unpleasant experience of use as revealed in the observations
Satisfaction	Kelly et al., 2007; Ranchhod & Loukis, 2012; Raybourn, 2007; Foster & Hopkins, 2011	Positive/ negative attitude as revealed in the observations Willingness to use it again as revealed in the observations
Organizational factors		
UNIDENTIFIED		Unfavourable conditions for SG use as revealed in the observations
The multidisciplinary project team	Nadolski et al., 2008; Raybourn, 2007; Thompson et al., 2010	Professional skills mobilized for the EHPAD SG Project: a geriatrician, the EHPAD Head, a head nurse, the IS project manager, an ICT project manager, a pedagogy/ scenario specialist, an application integration developer
Communication & interaction difficulties among the SG project teams	Howell, 2005; Kelly et al., 2007	Tensions appeared concerning choices of technical possibilities, their production costs and the demands from geriatric professionals. Several meetings were required before a consensus was reached
Minimum cost of a SG stands at under $50,000. It can go as high as $7m for a full 3D hospital reproduction project (SG Pulse)	Allal-Cherif & Bajard, 2011; Zyda, 2005	The total cost of the EHPAD's SG project was €180,000
SG user's individual factors		
Previous knowledge level	Cannon-Bowers & Bowers, 2007; Ritterfeld et al., 2009	Ease & difficulty of use as revealed in the observations Previously acquired knowledge as revealed in the observations Reading shortcomings as revealed in the observations
SG best suited for digital natives, age	Allal-Cherif & Bajard, 2011; Zyda, 2005 Alvarez & Djaouti, 2008; Thompson et al., 2010	***UNREVEALED*** The satisfaction of most staff members whose average age was 41, does not imply that these tools are better suited to younger staff
UNIDENTIFIED		SG use as a stressful factor
State of flow	Csikszentmihalyi, 2008	State of flow as revealed in the observations
Product factor: SG's quality		
Multimedia quality: Immersion & interactivity, simulation	Bell et al., 2008; Jercic et al., 2012; Ritterfeld et al., 2009	Multimedia quality as revealed in the observations Need felt for improved functionality as revealed in the observations Virtual world/ reality closeness
Scenario's content quality	Kelly et al., 2007; Nadolski et al., 2008; Zyda, 2005	Agreement & disagreement over the scenario as revealed in the observations Different approaches for the situations presented in the SG, as revealed in the observations Perceived usefulness as revealed in the observations

Table 5: Comparative synthesis of the different factors

CONCLUSION

This research evaluated a SG designed for the staff members of nursing homes for dependent elderly people. The serious game that was developed comprises three scenarios, namely resident admission, meal supervision and healthcare refusal. The evaluation consisted of observing how the staff members used the SG. Throughout the project, all significant events in the project's management were recorded in a logbook. The main results are as follows.

First, a large majority of both the catering and health care staff enjoyed using the SG as a training tool. Therefore, learner satisfaction, one of the SG's success criteria, has been met in our study. Moreover, from the remarks made by staff when using the SG, it can be assumed that the training objective was also achieved. It can therefore be stated that SGs are relevant and efficient training tools: our first research question is satifactorily answered.

Second, we evaluated the tool by conducting a fourth generation evaluation with medical experts and a third generation evaluation with the targeted staff members. The context of the experts' evaluation is specific because it occured only once, during the SG's co-conception. The evaluation by staff was based on observing how they reacted while using the tool, and is thus third generation, relating to judging the tool, answering our second research question. A different procedure would probably be required if the tool was to be introduced in many other EHPADs, as the observation phase

consumes significant resources. Alternatively, in a future study, once users have tested the SG they could be asked to fill out an interactive questionnaire evaluating both the tool's training contents and its multimedia dimension.

Third, we were able to link the categories we observed to the ISSM model (cf. appendix A) and check the model's causal feature against the ISSM model (Delone & McLean, 2003). This shows that the ISSM model can be applied in the context of SGs. Furthermore, our observations also permit making links with other models used in IS research. These include UTAUT (Venkatesh et al., 2003; Bourdon & Hollett-Haudebert, 2009) and the Triandis' model of Interpersonal Behaviour (TIB) (Triandis, 1979; Limayem & Rowe, 2006) with for example, positive / negative attitude, willingness to use the SG (UTAUT and TIB), stressful experience due to perception of being graded (TIB), or facilitating / unfavorable conditions like the lack / presence of situational constraints on behavior (UTAUT and TIB).

Fourth, we compared the results from the literature to those in our qualitative analysis. From our observations two factors arose which were not mentioned in the literature, namely conditions unfavourable for SG use, and the SG's stressful nature. The two parameters can be better mastered through more explicit communication with the staff on the goal of SG use (training and non-evaluation of staff members), through better planning management, and by making the SG available for staff to use in their homes.

As with any research, there are limitations that should be pointed out and which could be the subject of future studies. These limits are conceptual and methodological. The conceptual limitations concern the evaluation of serious games. During the project, our understanding of the purpose of the research gradually increased and it became apparent that the individual impacts, such as net profits or improving learning do not reflect all the dimensions of the SG's value, namely the potential for e-learning (Houze & Meissonier, 2005). We then conducted "before-after" tests for each scenario based on daily reports, but the profile of the individuals in these institutions, elderly and dependent people suffering from ageing and disease, may interfere with the results. For future research, we propose use of an evaluation approach through the SG's value, because it will provide readily identifiable outcomes such as patrimonial value, use value and exchange value. There are three dimensions of value that we believe ought to be considered in future research.

First, patrimonial value concerns the quality of IT business assets (hardware, software and team know-how). Information Systems operational excellence depends on the value of these assets, measured by qualitative and quantitative indicators. In serious games this technical quality includes both the quality of IT systems (response time of serious games, time calculation and 3D display), and the quality of maintenance (patches, updates).

Use value, the second category, concerns the contribution of Information Systems in support of business and organizational processes. For the evaluation of a serious game whose objective is staff training, the contribution of Information Systems to business performance can be measured by Human Resources tools, such as the Kirkpatrick Model (Kirkpatrick, 1998) Level 4: assessment of results and their impact on organizational indicators.

Finally, exchange value, the third category of value is characterized by the volume and quality of electronic communication with partners (suppliers, customers, etc.) and the nature of the interaction they maintain (competition or cooperation). For serious games this product exchange value also concerns the national training centre of local authorities (named CNFPT), as well as the SG publishing company.

Methodological limitations relate to the use of the case study. We chose this method because the project took place in the context of a call for project proposals with the Échirolles nursing home. However, access to such institutions is difficult because of confidentiality issues, concerns relating to their poor image, and because of limited staff availability. Moreover, we cannot exclude the "Hawthorne effect", the satisfaction and high acceptance of SGs may have been amplified by our involvement with the nursing home staff in Échirolles. We therefore propose using the SG in other healthcare facilities by implementing a quantitative survey.

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APPENDIX A: DELONE AND MCLEAN'S (2003) IS SUCCESS MODEL
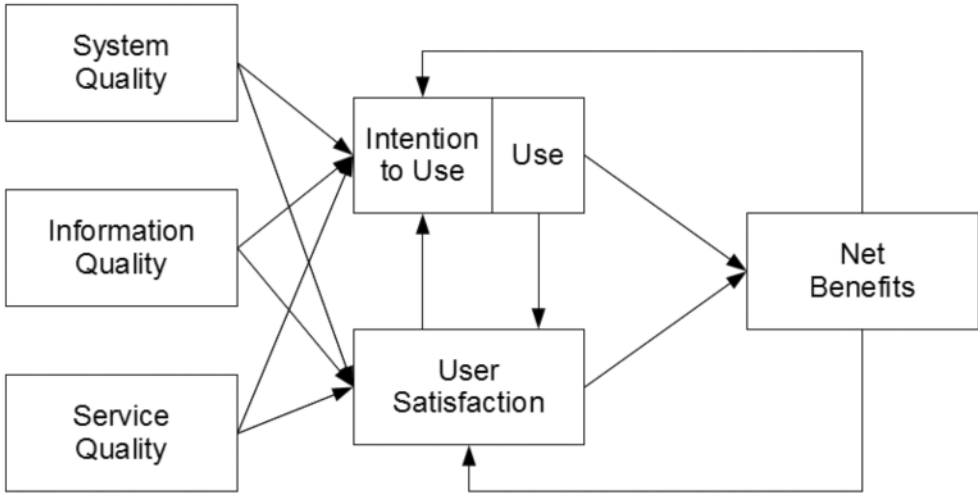
APPENDIX B: CATEGORIES ACROSS THE THREE SCENARIOS

Categories	Deductive/ Inductive	Total nb of occurrences	weight %
Flow	*IND*	*122*	*14,52*
Pleasant use experience	*DED*	*95*	*11,31*
Will use SG again	*IND*	*75*	*8,93*
Positive attitude	*DED*	*68*	*8,10*
Ease of use	*DED*	*62*	*7,38*
Sense of learning	*DED*	*47*	*5,60*
Unfavorable conditions	*IND*	*46*	*5,48*
Different approaches to situations presented in the SG	*IND*	*43*	*5,12*
Perceived usefulness	*DED*	*41*	*4,88*
Stressful experience	*IND*	*30*	*3,57*
Comparison between virtual/real world	*IND*	*25*	*2,98*
Scenario quality	*DED*	*22*	*2,62*
Multimedia quality	*DED*	*19*	*2,26*
Disagreement with the scenario	*DED*	*18*	*2,14*
Need for improved functionality	*IND*	*17*	*2,02*
Reading difficulty	*IND*	*16*	*1,90*
Difficulty of use	*DED*	*14*	*1,67*
Negative attitude towards use	*DED*	*14*	*1,67*
Previously acquired knowledge	*IND*	*12*	*1,43*
Difficulty using computers	*IND*	*10*	*1,19*
Team spirit	*IND*	*8*	*0,95*
Need for new functionality	*IND*	*5*	*0,60*
Comparison with video games	*IND*	*5*	*0,60*
Positive social influence	*IND*	*4*	*0,48*
Facilitating conditions	*IND*	*4*	*0,48*
Unpleasant experience	*IND*	*4*	*0,48*
Influence of nursing homes' problems	*IND*	*4*	*0,48*
Computer skills	*IND*	*2*	*0,24*

Table key: *IND*: inductive categories *DED*: deductive categories

Shadowed cells: removed categories

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APPENDIX C: CATEGORIES BY SCENARIO

Code	DED/ IND	SC1	SC2	SC3
Flow	*IND*	*36*	*49*	*37*
Pleasant use experience	*DED*	*30*	*27*	*38*
Will use SG again	*IND*	*8*	*24*	*43*
Positive attitude	*DED*	*17*	*23*	*28*
Ease of use	*DED*	*22*	*16*	*24*
Sense of learning	*DED*	*22*	*3*	*22*
Unfavorable conditions	*IND*	*15*	*12*	*19*
Different approaches to situations presented in the SG	*IND*	*16*	*7*	*20*
Perceived usefulness	*DED*	*6*	*7*	*28*
Stressful experience	*IND*	*10*	*6*	*14*
Comparison between virtual/real world	*IND*	*8*	*5*	*12*
Scenario quality	*DED*	*13*	*5*	*4*
Multimedia quality	*DED*	*16*	*1*	*2*
Disagreement with the scenario	*DED*	*4*	*11*	*3*
Need for improved functionality	*IND*	*10*	*3*	*4*
Reading difficulty	*IND*	*6*	*7*	*3*
Difficulty of use	*DED*	*8*	*3*	*3*
Negative attitude towards use	*DED*	*5*	*6*	*3*
Previously acquired knowledge	*IND*	*7*	*3*	*2*
Difficulty using computers	*IND*	*6*	*3*	*1*
Team spirit	*IND*	*7*	*0*	*1*
Need for new functionality	*IND*	*2*	*0*	*3*
Comparison with video games	*IND*	*5*	*0*	*0*
Positive social influence	*IND*	*3*	*0*	*1*
Facilitating conditions	*IND*	*1*	*2*	*1*
Unpleasant experience	*IND*	*1*	*2*	*1*
Influence of nursing homes' problems	*IND*	*0*	*0*	*4*
Computer skills	*IND*	*1*	*0*	*1*

Table key: *IND*: inductive categories *DED*: deductive categories

Shadowed cells: removed categories