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DIGITAL SERIOUS GAMES AS TOOLS TO SUPPORT EDUCATION: INFORMATION PRACTICES OF TEACHERS, INTEGRATION PERSPECTIVES AND CHALLENGES OF THEIR PRESERVATION AT THE FRENCH NATIONAL LIBRARY (BNF)

Abstract
During the last decades, Serious Games (SG) have emerged as innovative educational tools that blend learning with entertainment, addressing the challenges of digital and pedagogical shifts. However, incorporating these hybrid instruments into teaching methods and preserving them as cultural artifacts presents considerable obstacles. This research investigates the information-related behaviours of teachers and pedagogical engineers who work with Serious Games. Furthermore, this paper examines the efforts of the French National Library in preserving SG within its legal deposit framework, highlighting the complexities of archiving these digital artifacts. The findings reveal diverse informational practices, a need for specialized support in SG integration and challenges in long-term preservation.

Introduction

In an era characterized by digital and pedagogical transitions, Serious Games emerge as promising tools capable of combining learning and entertainment. These digital artifacts, situated at the intersection of playful and educational approaches, are often viewed as innovative instruments to support educational transformations. However, beyond widely circulated technophilic discourses, the reality of their integration into field practices is far from straightforward. Numerous technical, organizational, and social constraints limit their adoption by teachers and other educational actors, despite institutional directives encouraging the digital transformation of educational systems. Moreover, beyond their educational integration, Serious Games also raise the question of their heritage preservation. These digital objects, often ephemeral due to technological obsolescence and rapid changes in digital platforms, risk disappearing without concerted efforts to ensure their preservation. Furthermore, they are not edited by big companies and are often develop by individuals, without the infrastructure to spread them. Yet, as artifacts reflecting the social, technological, and educational contexts of their time, their conservation holds essential cultural and historical importance. This challenge calls for a broader reflection on the roles of institutions,

such as the National Library of France (BnF), and on the need to document and valorize these hybrid objects. BnF offers an opportunity to bridge the gap between information practice and preservation. BnF holds significant collection of Serious Games, yet its role remains largely underutilized by teachers and pedagogical engineers.

This article therefore proposes to examine how Serious Games, as tools supporting educational transitions and as heritage objects, fit into these complex dynamics. Through an approach combining theoretical analysis and study of field practices, it will explore the following questions: What are the information practices of teachers and pedagogical engineers related in the context of Serious Games? What are the technical, institutional, and social obstacles to the integration of Serious Games in educational practices? To address these questions, our research focused on analyzing the informational practices of educational game actors (teachers and pedagogical engineers). We employed the concept of *informational horizon* as a framework to comprehend their informational environment. Using a mixed methodology that combines qualitative analyses and informational mapping, we aim to present a model of actors' informational engagement with SG, offering a perspective on the challenges and opportunities for their successful integration into the educational landscape.

Definition of Serious Games

Serious Games (SG), defined as "*any game whose primary purpose is not entertainment*" (Michael & Chen, 2006), are increasingly utilized in education to enhance learning. Effectively incorporating these games into teaching requires a specific skill set from educators. However, the concept of SG varies among authors, particularly in its definition. In our work, we adopt the more precise definition proposed by Julien Alvarez, an expert in Information and Communication Technologies for Education (ICTE), who describes them as "*Computer applications that aim to combine serious aspects (Serious) such as, but not limited to, teaching, learning, communication, or information, with playful elements derived from video games (Game)*"(Alvarez, 2007). This theoretical foundation serves as the basis for our approach. Bridging the challenges of education through and with digital technology with questions rooted in Information and Communication Sciences (ICS), our study aims to examine the informational practices of various actors involved in SG development.

Teachers Information Practices

We consider SG as specific educational resources at the border between gaming and pedagogy, beyond merely assessing their pedagogical utility. Our doctoral research explores how different stakeholders (teachers, SG designers, information mediators) navigate this informational landscape to effectively identify, select, disseminate, and integrate these tools into their pedagogical practices. Grounded in Information and Communication Science, this study seeks to identify the informational practices of diverse actors linked to the use, development, and management of SG. Despite growing interest in using SG for educational purposes, there is a lack of research addressing how teachers, when seeking information, find, choose, and employ SG.

Given the diversity of actors involved, developing a methodology tailored to collecting information specific to each represents an initial challenge. What are the various information sources and needs of those involved in designing, using, and providing access to SG?

What are the obstacles and opportunities for SG dissemination and preservation? To address these questions, our research focused on analyzing the informational practices of educational game actors (teachers and instructional designers). We employed the concept of *informational horizon* as a framework to comprehend their informational environment. Using a mixed methodology that combines qualitative analyses and informational mapping, we aim to construct a model of actors' informational engagement with SG, offering a new perspective on the challenges and opportunities for their successful integration into the educational landscape. This issue prompts a reflection on the specific informational practices generated by SG and paves the way for pedagogical innovation strategies informed by a nuanced understanding of educational actors' informational landscapes.

Studies on Information Practices in Information and Communication Sciences

Information practices encompass the behaviors, habits, and skills individuals employ in utilizing, seeking, and managing information. These practices are continuously evolving due to technological advancements and the increasing complexity of the information landscape. Various research studies have explored different aspects of information practices in diverse contexts. However, studies on teachers' information practices related to identifying or using Serious Games (SG) are scarce or nonexistent to our knowledge. Therefore, we have focused on studies about information practices in general. In their research on teachers' information practices concerning online institutional resources, Aillerie and Harisoa (Aillerie & Rakotomalala Harisoa, 2020) employed a mixed quantitative and qualitative methodology to examine teachers' perceptions and actual use of these resources. The findings indicate a prevalence of individual usage, highlighting the importance of reliability and institutional specificity. The study also reveals a significant need for training and support to integrate these resources into pedagogical practices, emphasizing the role of peer sharing and exchanges, and the importance of a collaborative approach in their utilization. Ellis and Haugan (Ellis & Haugan, 1997) identified six information-seeking strategies: browsing, monitoring, directed searching, question-based searching, recall-based searching, and serendipitous searching. To better comprehend these various factors, it is necessary to analyze these practices, known as information practices. The literature abounds with definitions of the concept of "Information Practices." For this study, we approach information practices as defined by Chaudiron and Ihadjadene: "*the way in which a set of devices, formal or informal sources, tools, and cognitive skills are effectively mobilized by an individual or group of individuals in different situations of production, research, organization, processing, use, sharing, and communication of information* (Chaudiron & Ihadjadene, 2010). Pamela J. McKenzie (McKenzie, 2003) defines information practices as the actions and behaviors individuals adopt to search for, evaluate, select, organize, and use information in everyday life. She proposes a six-stage model to describe the information-seeking process: initiation, selection, exploration, formulation, collection, and presentation.

Information Horizon of Digital Serious Games Actors

Our research draws inspiration from the works of Sonnenwald (D. Sonnenwald, 1999; D. H. Sonnenwald et al., 2001), Huvila (Huvila, 2009), and Savolainen (Savolainen & Kari, 2004) on the concept of *Information Horizon*. Introduced to Information and Communication Sciences by Diane Sonnenwald, this concept proposes that within a specific context and situation, an "*information horizon*" exists in which we can operate. Key factors such as decisions made, information-seeking processes, resource accessibility, individual preferences, and situational impacts on these processes shape this horizon. In our case, we aim to guide teachers and serious game designers to identify their information sources according to five categories: Human sources, printed sources, online resources (websites), organizations, and others. Then, we asked them to classify these sources into primary information zone, secondary information zone, and peripheral information zone. The *information horizon* concept has been the subject of several studies in information and communication science. Raijo Savolainen and Kari (Savolainen & Kari, 2004) examined how individuals perceive the relative value of the internet when seeking information on personal development. Drawing from Sonnenwald's work, they proposed a model for ranking various information sources and channels according to preference in addressing an information need. In a 2022 study, Joanne du Hommet, Madjid Ihadjadene, and L. Grivel (Joanne du Hommet et al., 2022) investigated how professionals in an entertainment company define their information horizon and the factors influencing them. Applying Savoleinen's concept, they proposed a new categorization of information sources and confirmed the typology of criteria established by the latter. They discovered that the context of coopetition and technological advancements significantly influence the informational practices of gaming professionals. Isto Huvila (Huvila, 2009), in his article "*Analytical Information Maps*," analyzes information behaviors in professional settings based on Diane Sonnenwald's theory. He develops a data collection method that complements interviews as a means of gathering data. Using interview recordings of Finnish and Swedish archaeology professionals, he creates diagrams called *analytical information horizon maps* to visualize, communicate, and structure individual and shared patterns of information resource use and the organization of information-seeking activity.

Research Field and Data Collection and Methodology

In our study, the research field is defined through a dynamic and evolving process, developing as we progress and utilizing various means and intermediaries. One such intermediary is the Computer Science Laboratory at the University of Le Mans (LIUM), which comprises educational designers and engineers who assisted us in gathering essential research elements. We conducted several activities, including game experimentation, on-site observation (particularly at the BnF, which houses a substantial collection of Serious Games), and consultation with information-documentation professionals. We also organized a participatory workshop with educators and educational engineers from the "*Pays de la Loire region*", employing the concept of *Information Horizon* as defined by Diane Sonnenwald in Information and Communication Sciences. This approach enabled us to adopt a more collaborative and innovative method, which will be

supplemented by other information-gathering techniques such as questionnaires. This methodology is not only suitable for our participants but can also be applied in other contexts. Building on the workshop we organized with LIUM in late march 2023, we collected information that contributed to shaping our research field. Once all this data is gathered, we will have a diverse set of heterogeneous information that will require rigorous analysis. We will employ a transversal approach, linking Serious Games with the information horizon concept.

Key Findings and Discussion

The workshop held during the EdTech day at Le Mans University, 31 participants, including secondary and higher education teachers and educational engineers, explored their *information horizons* related to Serious Games (SG). This interactive session required them to identify and categorize their information sources into three concentric zones, reflecting their relevance: primary, intermediate, and peripheral information zones, as illustrated in the figure below. In accordance with Savolainen's study, we assigned a weight to each information zone to determine the relevance of one zone relative to another. Zone 1 = 3, Zone 2 = 2, Zone 3 = 1. The average weight represents the relative importance of each source. The total weight represents the product of the average weight of each category of information sources. The "Total sources" represents the total number of sources for each category of information sources (see Table 1).

Type of sources according to Savolainen	**Average score**	**Total score**	**Total sources**	**Zone 1**	**Zone 2**	**Zone 3**	**%**
Human Sources	2,48	156	63	38	17	8	22%
Printed Sources	1,98	91	46	12	21	13	16%
Websites – Online sources	2,19	221	101	38	44	19	35%
Organisational sources	1,96	100	51	14	21	16	18%
Other sources	2,11	57	27	9	12	6	9%
Total			288	111	115	62	100%

Table 1. Types of sources according to Savolainen.

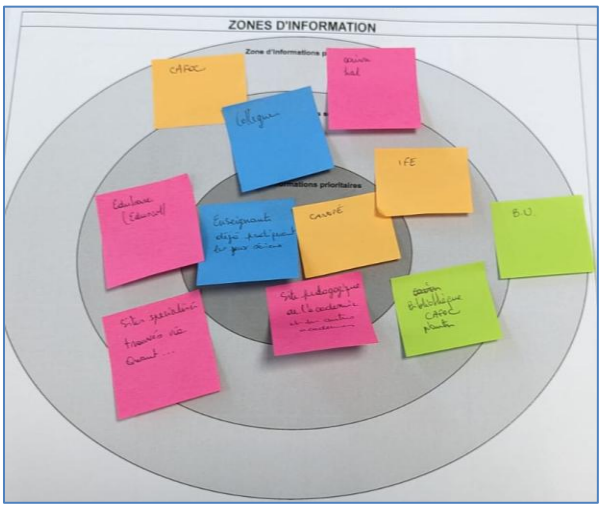

Figure 1. A participant's information sources positioned from Zone 1 to 3.

Semi-Structured Interviews

Our study engaged teachers and instructional engineers from diverse disciplines, all demonstrating an interest in Serious Games (SG). This diversity enriched our understanding of the various approaches adopted to integrate SG into educational practices, revealing a spectrum of experiences ranging from novices to advanced users. Thematic analysis of the interviews highlighted the participants' varied information practices in their efforts to effectively incorporate SG into teaching contexts. Three primary profiles emerged from the data:

- **Experts**: individuals proficient in using SG within their teaching methodologies.
- **Curious Explorers**: Individuals actively exploring the potential of SG for educational purposes.
- **Enthusiasts**: individuals passionate about deepening and sharing their knowledge on SG.

The sources of information used to explore and adopt SG varied widely and included search engines, academic websites, professional networks, and specialized events. These channels reflected the participants' diverse needs and educational contexts, underscoring the importance of online research skills and information monitoring to filter and identify relevant resources. Peer interactions and experiential feedback also played a pivotal role, facilitating the exchange of advice and recommendations. Despite the diversity of experiences and practices, common challenges were identified. Participants reported difficulties in finding SG that were appropriately tailored to specific educational contexts, often criticizing available games as overly simplistic or child-centric. The integration of SG required significant investments of time and resources, with participants expressing the need for additional support in adapting and developing these games.

From a pedagogical perspective, SG were primarily employed as tools for introducing or interacting with educational content, enriching the learning experience through practical simulations or role-playing activities. Some educators demonstrated innovative approaches by

leveraging SG to address complex topics, such as cybersecurity, through interactive exercises that engage and sensitize students.

An important and yet unexplored connection exists between the preservation efforts of the French National Library (BnF) and the information practices of teachers and pedagogical engineers. As the table shows (Table.1) only 16% percent of them use institutions to find information related to Serious Games. The national Library plays an important role in documenting and safeguarding Serious Games through its collection and the 1992 legal deposit mandate. However, findings from our research suggest that BnF resources are not mentioned within their information practices. This gap highlights a disconnect between the archival potential offered by BnF and the practical needs of educational actors in search of accessible and adaptable SGs. Addressing this disconnect could foster collaboration and utilization of preserved SGs, enabling educators to integrate these resources more effectively into their teaching practices.

The French National Library (BnF) and Serious Games preservation

The French National Library (BnF) has been a key actor in the preservation and documentation of Video Games, leveraging its mandate as part of the legal deposit framework established in 1992. This framework positioned the BnF to recognize the cultural and educational significance of multimedia documents, including SG, which have evolved into components of the broader digital and cultural heritage landscape.

Serious Games Preservation Efforts at BnF

The BnF's collection of SG has grown through a combination of legal deposits, donations, and acquisitions. Notably, the library has supplemented its collection with software and games predating the 1992 legislation to address gaps in its archive. One example is the acquisition of educational software originally curated by the Centre d'Étude des Systèmes et Techniques Avancées (CESTA), a center established in 1982 to promote new technologies. This archival effort extends to capturing the educational initiatives of the 1980s, such as the "*Informatique pour Tous*" program, which introduced microcomputers into schools.

However, the preservation of SG presents unique challenges. Unlike traditional media, SG are prone to hardware and software obsolescence, complicating their long-term accessibility. For instance, early SG designed for platforms like the Magnavox Odyssey or Thomson MO5 often require emulation to remain usable. Additionally, contemporary SG often exist solely in online formats, posing significant barriers to preservation due to their reliance on transient web environments and complex licensing arrangements.

Challenges in Collecting SG

The BnF faces numerous obstacles in its efforts to collect and archive SG:

Non-Spontaneous Deposits: Many creators and publishers of SG are not proactive in submitting their works to the BnF, particularly those distributed digitally or via web platforms.

Economic Confidentiality: Publishers frequently cite economic confidentiality concerns, limiting the library's access to proprietary content.

Complex Stakeholder Relationships: Identifying the responsible parties for SG creation, particularly in cases where games are commissioned by external entities, complicates the deposit process.

Lack of Offline Versions: Many SG are developed exclusively for online platforms, and obtaining offline versions for archival purposes often requires negotiation with publishers, which is not always successful.

Significance of the BnF's Work

Despite these challenges, the BnF remains committed to preserving SG as part of France's cultural and educational heritage. The library's work ensures that researchers and educators can analyze SG to evaluate their design, educational methodologies, and broader cultural implications. By fostering collaboration with researchers, game developers, and publishers, the BnF continues to advocate for sustainable solutions to preserve SG and make them accessible to future generations. Through its initiatives, such as workshops and partnerships with academic and industrial stakeholders like the Play Research Lab, the BnF emphasizes the interdisciplinary significance of SG.

Conclusion and perspectives

This study highlights the role of Serious Games as both educational tools and cultural artifacts requiring preservation. By examining the Information Practices of teachers and pedagogical engineers, as well as the challenges faced by institutions like the French National Library in preserving SG, we underscore the need for stronger connections between preservation efforts and practical preservation applications.

Looking ahead, we will the scope of this research to include interviews with Serious Games designers and information specialists (librarians).

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