



GSGS'22

7TH INTERNATIONAL CONFERENCE ON GAMIFICATION & SERIOUS GAME

June 29 – 30 & July 1, 2022 | HEPIA, HES-SO | Geneva

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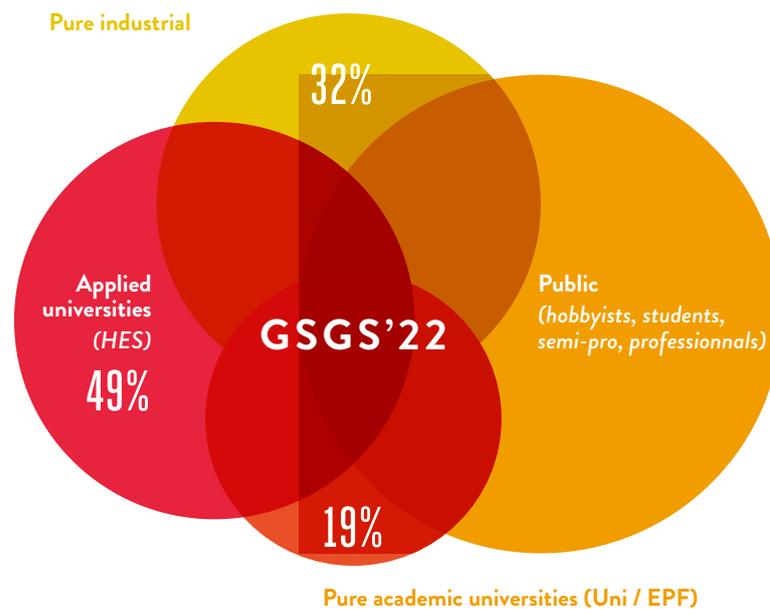
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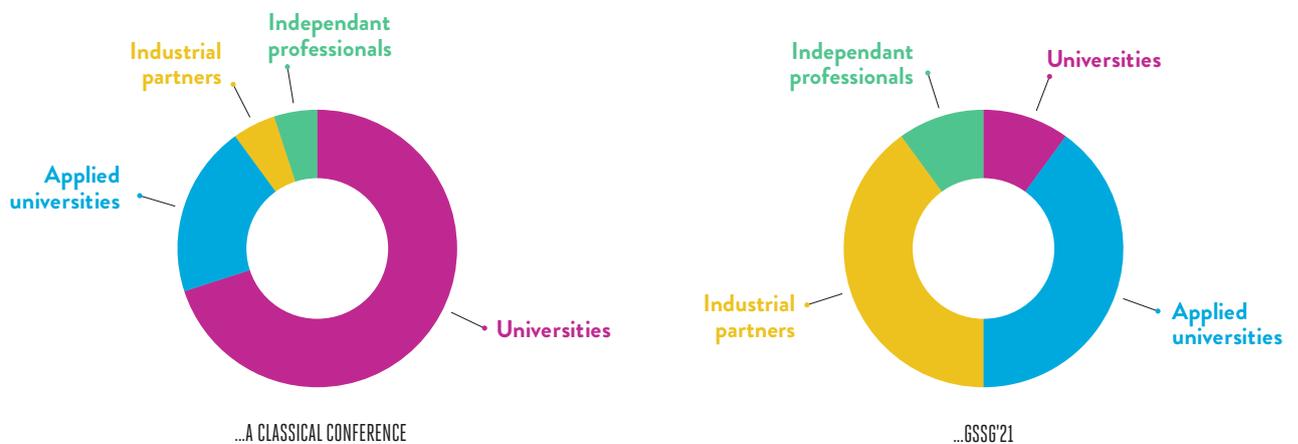
GSGS'22: AN INTER-PROFESSIONAL OPPORTUNITY FOR THE SWISS INDUSTRY

The market for industrial gamification and serious games has grown from 1 to 20 billion euros in 10 years, and the same growth is expected within the next decade. In this context, the GSGS supports the link between the industrial needs and the innovation envisioned by applied research universities. Accordingly, the GSGS'22 aims to reinforced the needed but indeed fragile bridge between industrial and academic partners. It highlights the playful perspective to tackle technical, training, ecological, management and communication challenges. Bringing together the strengths of academy and industry, this event provides an exchange and networking platform through the intervention of national and international actors.



Four categories of people interacting to rise innovation.

WHAT CAN BE EXPECTED AT...



WEDNESDAY, JUNE 29 PRE-CONFERENCE ACTIVITIES

WORKSHOP SERIOUS GAMES & GAMIFICATION FOR INDUSTRY

- 09:00 – 09:15 Introduction speech
- 09:15 – 10:00 Industrial Project Gamification: from need to concept to product
- 10:00 – 12:00 Case studies & Group work
- 12:00 – 12:30 Apéro & Networking

TUTORIAL INTRODUCTION TO UNITY GAME ENGINE

- 14:00 – 14:10 Introduction speech
- 14:10 – 15:00 Unity: Main Concepts & Scripting
- 15:00 – 17:00 Developing simple examples
- 17:00 – 17:15 Conclusion

What is the _ _ _ _ _ ? _ , _ , or _ ?

Education  ★ ★ ★ ★	Abstract  ★ ★ ★ ★	collaborative  ★ ★ ★ ★	Outcome  ★ ★ ★ ★	
Keywords  ★ ★ ★ ★	Develop  ★ ★ ★ ★	Allows  ★ ★ ★ ★	Edutainment  ★ ★ ★ ★	Framework  ★ ★ ★ ★

 Finding missing words: for each paper, find the provided hint and add the binary-stars
Verifying answer to the question: add it to <http://gsgs.ch/>

GSGS'22 editorial gamification: the → gift 4 the 1st → guess 😊

THURSDAY, JUNE 30 CONFERENCE SESSIONS

Welcome & Coffee

09:30 – 09:45 Opening and Welcome Speeches

SESSION A POLITICS, ECONOMY & SOCIETY**CHAIR SOPHIE WALKER | ZHDK | ZÜRICH**

- 09:50 – 10:05 **1** PBI - The Game: A cooperative game on the protection of human rights defenders
Johan Jaquet | Peace Brigades International Suisse | Switzerland
- 10:05 – 10:20 **2** Showcasing game prototypes designed during the Serious Games Generalist program
Loïc Hans | Entrée de Jeux | Switzerland
- 10:20 – 10:35 **3** “Let's Help together”: am I serious?
Olivier Reutenauer | DIGITAL KINGDOM SARL | Switzerland

Coffee break

SESSION B BUSINESS, COMMUNICATION, MANAGEMENT**CHAIR YASSIN REKIK | HEPIA | GENEVA**

- 10:50 – 11:05 **4** A Serious game for firms to reduce ecological footprint by using Information System
Steve Berberat | He-Arc Gestion | Switzerland
- 11:05 – 11:20 **5** Extending SQL Scrolls to Teach SQL DML
Ela Pustulka | FHNW | Switzerland
- 11:20 – 11:35 **6** Contrast of students' emotional engagement during game-based learning
Xavier Wilain | Swiss Hotel Management School | Switzerland

THURSDAY, JUNE 30 CONFERENCE SESSIONS

- 11:40 – 12:30 **7** **Keynote Speaker 1**
How interaction modalities affect serious games and exergames efficacy
Fabio Solari | University of Genoa | Italy

Lunch Break

- 13:45 – 14:30 **8** **Keynote Speaker 2**
Gamification to support data protection awareness in small businesses
Bettina Schneider | FHNW | Switzerland

SESSION C HEALTH**CHAIR** **RENAUD OTT | MINDMAZE INC. | LAUSANNE**

- 15:15 – 15:30 **9** **A Web-Based Framework for the Management of VR/AR Multi-Platform Exergames**
Fabio Solari | University of Genoa | Italy
- 15:30 – 15:45 **10** **PRITS: A serious game for Law Education**
Dominique C. de Oliveira | HESAV | Switzerland

Coffee Break

- 15:50 – 16:20 **11** **Keynote Speaker 3**
Natural Language Interaction for Games and Gamification
Jonathan Lassard | Concordia University | Canada
- 16:30 – 17:30 **12** **Round Table 1**
- 18:00 – 23:00 **Social Event - Trip & Dinner on Geneva Lake**

FRIDAY, JULY 1 CONFERENCE SESSIONS

Welcome & Coffee

SESSION D TRAINING

CHAIR STEPHANE MALANDIN | HEPIA | GENEVA

- 09:35 – 09:50 **13** Virtual Escape Game as part of a Bachelor's and Master's degree finance course
Fabien Degoumois | HES-SO | Switzerland
- 09:50 – 10:05 **14** Dynamilis: the app that helps 5-12-year-old children improve their handwriting
Thibault Asselborn | EPFL | Switzerland
- 10:05 – 10:20 **15** APP CODIFICIO 2.0
Ariel Cortes | Pontificia Universidad Javeriana | Colombia
- 10:20 – 10:35 **16** Virtual Reality Simulator Training for Teenagers with Intellectual Disabilities
Marine Capallera | HEFR HumanTech Institute | Switzerland

Coffee break

SESSION E ART, CULTURE, TOURISM & ARCHITECTURE

CHAIR FLAVIO ROTH | SECOND SPECTRUM INC. | LAUSANNE

- 10:50 – 11:05 **17** Sarnetz: Raising awareness about CO₂ neutrality in a collaborative serious game
Janina Woods | HSLU | Switzerland
- 11:05 – 11:20 **18** "BATVISION" Experiential Learning through Virtual Reality
Eliane Zihlmann | ZHDK | Switzerland
- 11:20 – 11:35 **19** "The Thief of Homburg", a game combining archeology with modern game design to convey Swiss cultural sites.
Mathis Ebner | Diditopia Games GmbH | Switzerland

FRIDAY, JULY 1 CONFERENCE SESSIONS

11:40 – 12:30 **20** Keynote Speaker 4
Expanded Games
Douglas Edric Stanley | HEAD | Switzerland

Lunch break

14:00 – 14:50 **21** Keynote Speaker 5
x-ode: urban rendezvous through mixed reality
Pascal Maeder & Urbanoid development team | Urbanoid | Switzerland-Canada

SESSION F EDUCATION & TRAINING

CHAIR GUY HALLER | HUG | GENEVA

15:00 – 15:15 **22** Chemicastle: helping students to understand
the structure-property relationship
Olga Reinauer | Private project | Switzerland

15:15 – 15:30 **23** LusTra (Ludique in French, sorting Trash in English)
Swann Puig | HEPIA | Switzerland

15:30 – 15:45 **24** Professional Training via Gamified Augmented Reality Application
Yassin Rekik | HEPIA | Switzerland

Lunch break

16:00 – 17:00 **25** Round Table 2

17:30 – 18:00 Trophees Ceremony & Closure



ROUNDTABLES, QUESTIONS & DISCUSSIONS

Julien Schekter

Head of communications
DFJC (Education, Youth and Culture Department)
Vaud, Switzerland

THURSDAY, JUNE 30

16:30 – 17:30

Round Table 1

**Industry Adoption of Gamification
and Serious Games: How to Take Action?**

As Serious games and gamification are present, well accepted and progressing in some areas like health, military training, education or culture, the industry sector is still a world to conquer. What are the main triggers that could allow Serious game developers to convince that they have a credible and efficient solution for companies in the industrial sector? Is it visibility? Proof of efficiency? Critical size of the market and of game studios themselves? Or shall they just wait for the next generation of leaders and CEOs? This roundtable will address these issues and try to look one step further for actual solutions.

FRIDAY, JULY 1

16:00 – 17:00

Round Table 2

Gamification & Serious games into the Metaverse

In the last thirty years virtual reality and augmented reality opened new playfields for gaming, gamification, and Serious games. Each year, more and more games or simulations use their benefits. A shared or unified Metaverse could act as an accelerator or catalyzer by giving both the tools and the audience to any game solution developer. But what are those real benefits? And are we sure that the Metaverse is a huge opportunity or is it just another deceiving rush for technology rather than content? Is it time to really step into VR and bet on what has so many times been called the next big shift that will change society... but that never actually did? Let's imagine the future of gaming in a Metaverse with our guests in this second roundtable of GSGS 2022. Join in!



SESSION A POLITICS, ECONOMY & SOCIETY

THURSDAY, JUNE 30
09:50-10:35

In this session, we explore three initiatives that demonstrate how games can be used to support society. The educational solutions range from card games to digital narrative games and cover topics from international collaboration to professional training. “PBI- The Game” is a card game which conveys the practices of Peace Brigades International, an NGO specialised in the unarmed protection of human rights defenders. During a cooperation between the Arc Business School in Neuchâtel (HEG Arc) and the training and consulting company Entrée de Jeux, students created industry solutions in the form of, tabletop games, role-playing games, escape games or treasure hunts. For the game “Let’s Help together”, the Red Cross Vaud and the game studio Digital Kingdom developed a narrative game which presents the values and actions of the Red Cross Vaud by and its volunteers. Next to discovering these projects, we gain insights on their different design approaches and learnings.



CHAIR : SOPHIE WALKER



JOHAN JAQUET

PBi- The Game: A cooperative game on the protection of human rights defenders



LOÏC HANS

Showcasing game prototypes designed during the Serious Games Generalist program



OLIVIER REUTENAIER

“Let’s Help together”: am I serious?



1 | PBI- THE GAME: A COOPERATIVE GAME ON THE PROTECTION OF HUMAN RIGHTS DEFENDERS

Johan Jaquet^{1,2}, Katia Aeby¹

¹: Peace Brigades International Switzerland, Bern, Switzerland

²: Entrée de Jeux, La Chaux-de-Fonds, Switzerland

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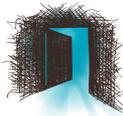
KEYWORDS

Serious game; Card game; Cooperative game; Education; Human rights defenders; Consensus; Non-violence; Non-governmental organisations.

SUMMARY

2 Serious games have gained credibility as tools for education and communication over the past decades, notably in the field of international cooperation. The present project aims at promoting Peace Brigades International (PBI), an NGO specialised in the unarmed protection of human rights defenders, through an interactive and accessible tool. The project was run in collaboration with Entrée de Jeux, a small company specialised in non-digital serious games. We designed a cooperative card game representing the specific activities of a PBI field team, as well as the organisation's principles: international cooperation, non-partisanship, consensus decision-making and non-violence. This game can be used either as a standalone game by people eager to discover the work of PBI, or as a facilitation tool for teenager workshops and trainings of future volunteers. In addition, a short version is used on the PBI booth in public events. Published in four languages, "PBI - The Game" was well received by users. Specifically, the members of the organisation consider the game as a useful introduction to explain the somewhat complex work of a PBI field team.





2 | SHOWCASING GAME PROTOTYPES DESIGNED DURING THE SERIOUS GAMES GENERALIST PROGRAM

Loïc Hans¹, Johan Jaquet¹, Michael Perret²

1: Entrée de Jeux, société coopérative, La Chaux-de-Fonds, Switzerland

2: Arc Business School, HEG Arc, Neuchâtel, Switzerland

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SUMMARY

Our booth will showcase several game prototypes made during the Serious Games Generalist continuing education program, given at the Arc Business School in Neuchâtel (HEG Arc), and in cooperation with the training and consulting company “Entrée de Jeux”.

The designers were participants with little or no prior knowledge in game design. The first part of the course was dedicated to the discovery and analysis of several forms of serious games. It aimed to give access to key resources on the matter. The second part focused on developing a personal project: game design and communication specialists coached the participants through the creation process.

The prototypes passed through test phases. Some of them entered the production phase: they take different forms, such as tabletop games, role-playing games, escape games or treasure hunts. Their application fields are related to mental health, watch industry, training, events, museography and tours.

The latest boardgame, produced by Entrée de Jeux, such as Local Beesness – a game that promotes “l’Abeille”, the local currency of La Chaux-de-Fonds – can also be discovered on the booth.

KEYWORDS

Serious games creation; Arc Business School; Entrée de Jeux; continuing education; training; game design; prototypes; tabletop games; role-playing games; escape games; mental health; watch industry; events; museography; tours.



3 | "LET'S HELP TOGETHER": AM I SERIOUS?

Olivier Reutenauer, Benjamin Vurlod, Mike Cotton-Russel, Elio Ramel, Luc Francey, Sandro Dall'Aglio

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A project carried out in partnership with the Vaud Red Cross, Lausanne, Switzerland

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KEYWORDS

Serious game; social; Croix-Rouge vaudoise: Digital Kingdom: cooperative; multiplayer.

SUMMARY

"Let's Help together" is the result of a partnership between "Digital Kingdom" and "the Vaud Red Cross" (Croix Rouge vaudoise), as part of the Numerik Games 2020-2021 festival. This multiplayer and cooperative game illustrates proximity and kindness. It also presents the values and actions of "the Vaud Red Cross" by illustrating the great work of its volunteers.

Through multiplayer game sessions on the booth, we propose to question and discuss the theme of serious gaming, its representation in the collective imagination, the part of fun and the part of message conveyed by the game. In this project, we chose to convey the messages entirely through gameplay and visuals, without using text.

Is "Let's Help together" serious? Is it a serious game, a video game? Can you find all the messages conveyed by the game?

"The great team at Digital Kingdom has managed to transcribe the social project that the Vaud Red Cross promotes with extreme finesse and a great sense of playfulness.", says Daniel Drainville, Director of "the Vaud Red Cross".

4





SESSION B BUSINESS, COMMUNICATION, MANAGEMENT

THURSDAY, JULY 1
10:50-11:35



CHAIR : YASSIN REKIK



STEVE BERBERAT

A Serious game for firms to reduce ecological



ELA PUSTULKA

Extending SQL Scrolls to Teach SQL DML



XAVIER WILTAIN

Contrast of students' emotional engagement
during game-based learning



4 | A SERIOUS GAME FOR FIRMS WILLING TO REDUCE THEIR ECOLOGICAL FOOTPRINT BY USING INFORMATION SYSTEM

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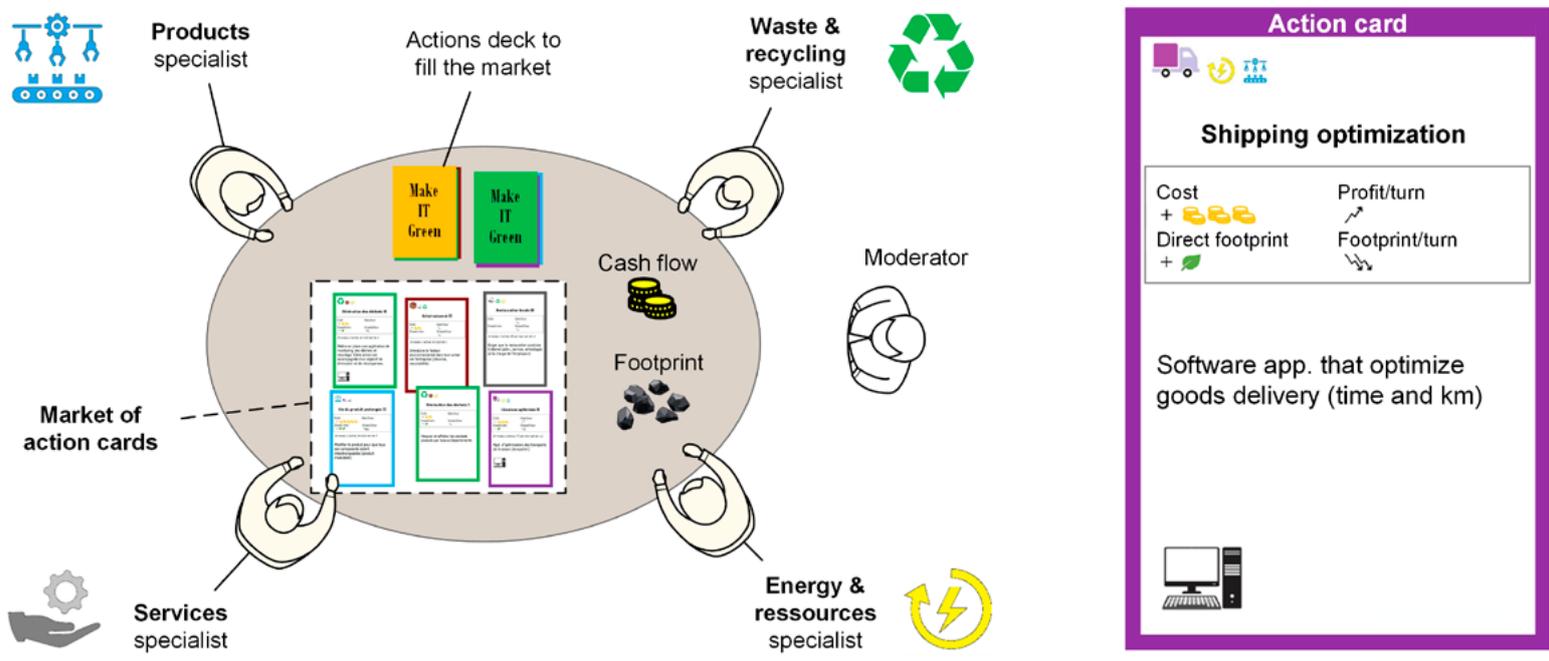
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ABSTRACT

Global warming increasingly becomes our society's main issue, implying an urgent need to reduce the global ecological footprint. Everyone and every entity are responsible for taking actions, however studies show that firms are not sufficiently engaged. We developed a serious game that makes them aware of, first, the green actions' benefits and, second, the opportunities offered by Green IS, which is a high-potential solution that uses software applications in order to reduce the firm's footprint.

KEYWORDS

Serious game; ecological footprint; environmental impact; information system; green IS; green IT; awareness raising; organization.





CONTEXT

Climate change is now obvious to everyone and has become one of our society's main concerns. The fact is that the Earth can only offer hospitality to humanity if its biomass capacity is sufficient, but this capacity is continuously decreasing mainly due to deforestation and greenhouse gas emissions, involving global warming, melting ice and natural catastrophes^[1]. Researchers and almost everybody now recognize the urgent need to tackle climate change by reducing the global ecological footprint. Although everyone and every structure are involved and responsible for the ecological footprint reduction, it is noticed that firms have a particular and important role to play in this issue^[2].

Green Information System appears as a good means to help firms reduce their footprint. Indeed, while the well-known green IT concept is about reducing consumption of information technology (IT), the concept of green IS is about implementing software applications – also called Information Systems (IS) – to leverage new and better practices in a firm to reduce its overall footprint^[3]. Green IS has a great and unexploited potential: whereas IT is about 2% of a firm footprint, the green IS can take part in reducing the other 98%^[4]. Combining technological innovation and requirements to lower environmental impacts, the green IS concept hence appears as an evident solution for the future.

TARGETED ISSUE

According to studies, actions to reduce ecological footprint have to be taken in all scopes, from individual to global. We see actions in several levels, but there is a deficit in the organizational one. On the one side, governments are committed to the Sustainable Development Goals (SDG) 2030 and set up incentive programs; regions and cities have established local policies and planned green projects related to eco mobility, energy production or buildings renovation; citizens try to adopt responsible behaviors. But on the other side, firms are not sufficiently engaged and do not initiate enough actions for sustainable development^[5] whereas they have a strategic role to play and could provide an essential contribution^[2]. Thus, there is a need to motivate them to take part in the issue.

There are two main reasons that keep a firm from initiating ecological actions. The first one is the lack of information about benefits and collaborators who take decisions need to be aware of them. They should understand that having gone green will increasingly provide a competitive advantage, as well as green projects often involve return on investment (ROI), despite the belief that these projects represent loss-making expenditures. The second reason is the lack of practical tools and methods to address this issue. Indeed, there is a need for efficient tools that helping and guiding firms to implement concrete solutions and give them confidence in the actions they undertake^[2].

PROPOSED SOLUTION

The main objective of the GreenIS-UP project was to provide a tool which makes firm's collaborators aware of possible green actions and of their ecological and financial benefits. The tool particularly focuses on Green IS actions, given that researchers point out a huge lack of environmental consideration in the IS research field^[3].

The developed tool is a collaborative serious game (SG). Two reasons explain this choice: first, studies confirm that SG has a real potential to promote learning and awareness; second, it has been demonstrated that participants who have played a serious game on sustainability adopt significantly more sustainable behavior^[6].

The result is a turn-based board game in which 4 participants, assigned as specialists in environmental impact area, must collaborate to invest in actions that will reduce the firm's footprint. In each turn, the participants must choose, in a market, which action cards to play. To achieve their choices, they must consider the firm's available cash flow and discuss the given cost and the given financial and environmental impacts of each of them. After 4 turns, the game ends, and the financial and ecological scores are established. At that time, participants observe a higher cash flow than initially and understand that actions involve a ROI and a company's footprint drop. As the game can be played on several tables simultaneously, it allows the score comparison of different tables.

The main objective of the Green IS-UP project was to provide a tool which informs firm's collaborators on possible green actions and their ecological and financial benefits.





Green IS serious game conception

RELEVANT INNOVATION

The proposed SG was the construction from both researchers and serious game practitioners. It was designed according to a rigorous methodology which directly incorporated scientific studies results in game elements: ¹ areas of environmental impacts of action cards and their information were retrieved from studies published by the ADEME agency; ² game mechanics was evaluated and selected from scientific census of learning mechanics ⁷ in order to guarantee an effective learning process during the SG – something that was managed by including at least one mechanic per learning phase; ³ drivers for adoption of green IS were integrated in the game, to increase the likelihood of participants to adopt some green IS ideas.

In addition to be designed from these scientific elements, the game was constructed in collaboration with “Entrée de jeu”, a company specialized in game conception and composed by serious games experts. Our game is the first, innovating and fun game that is relevant to inform organizations about the possibilities of ecological and green IS actions. It includes real and comprehensive action samples that really could improve a firm’s ecological footprint.

PROJECT OUTCOMES & RESULTS

The SG was tested and improved in 3 phases. The first one focused on playing with practitioners who were game and serious game experts. In this phase, the game was played 5 times; experts from “Entrée de jeu” and pro-gamers were selected in order to get reliable point of views and advice. The second test phase consisted in playing the game with newbies, which allowed us to verify the playability and the rules’ ease of understanding. To carry out sufficient improvement, we organized 4 game tests. Finally, the third phase was about playing the game in real conditions in firms. For this purpose, we selected 2 firms interested in sustainability. During each test of these 3 phases, we wrote every question and remark, given by participants and adjusted the game accordingly. We finally obtained a balanced and fully playable game that lasts 1 hour.

We measured the perceived benefits of the SG from firms’ collaborators, using a questionnaires them before and after each play. Results showed an increased awareness about both sustainability and green IS opportunities. After the play, all participants said they were convinced that ecological actions could be compatible with the firm’s financial expectations. Furthermore, participants increased by a half their intention to promote green actions in their firm. In one firm, a green IS project construction was even initiated after our intervention.

CONCLUSION

In a context where humanity is facing climate change, we have looked for a solution that combines innovation and firms’ ecological footprint reduction and developed a serious game (SG) for firms that make them aware of the opportunities that Green IS offers, which is a high-potential solution to reduce the footprint by using



software applications. The results showed that the developed SG effectively raised the participants' awareness and, moreover, increased their intention to promote real actions in firms.

PERSPECTIVES & NEEDS

The green IS serious game could provide much more than raising awareness in the firms. The feedback we received demonstrates that it can help to generate ideas on green actions and initialize real green IS projects. Thus, including it within a workshop should allow every firm to lever change and reduce its footprint.

The next step is to promote such a tool in a large number of firms and collect feedback for quantitative research. For this purpose, an online version of our SG might be developed.

ACKNOWLEDGEMENTS

This project is supported by ISnet RCSO research found of University of Applied Sciences and Art of Western Switzerland (HES-SO). We thank them as well as, the HEG Arc and HES-SO Wallis for the resources, Entrée de jeu and Planair for their partnership and all the contributors.

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5 | EXTENDING SQL SCROLLS TO TEACH SQL DML

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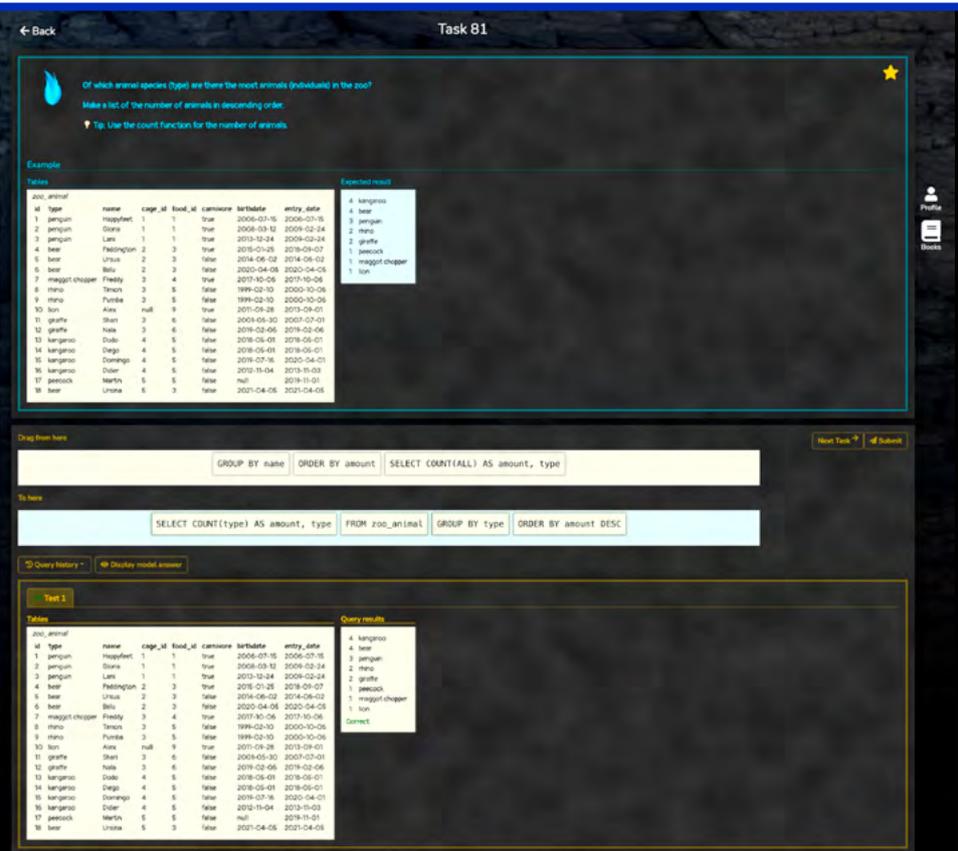
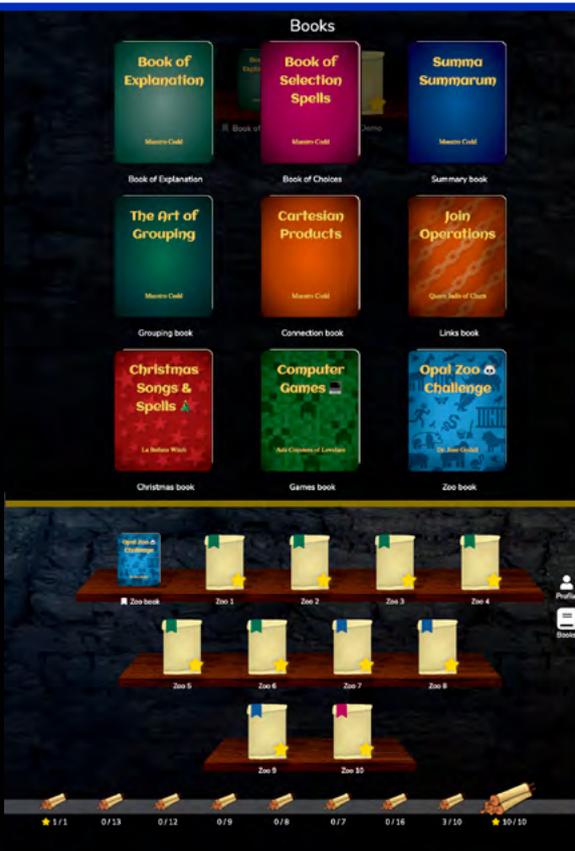
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ABSTRACT

SQL (Structured Query Language) allows a business user to communicate with a relational database. A learner who wants to master SQL needs practice, patience and motivation, which we support in a game called “SQL Scrolls”. Student surveys we carried out show that this approach encourages our students to practice and students are enthusiastic and want to see more games on other subjects. We are now extending the game to cover all of SQL DML and offer 500 questions.

KEYWORDS

DGBL; digital game-based learning; puzzle; SQL; teaching game; database.





CONTEXT

Structured Query Language is a very popular programming language used in communicating with relational database systems. Learning SQL and the foundations of databases is one of the important topics in both computer science and business courses in most universities. We teach SQL as part of a database technology course leading to a BSc in Business Information Technology. Beside SQL, our students learn Java, carry out a programming project, and optionally learn another language. Students need exercise material as SQL programming is a skill requiring a lot of practice, see Ahadi et al.^[1] The parts of SQL we teach are shown in Figure 1. The traditional way to practice is to use book examples which focus on business topics, and code SQL within a database benchwork. Using the benchwork is complex and needs practice. The teacher guides the students in class in both SQL and benchwork use. The idea behind SQL Scrolls is to introduce SQL exercises which use a game to motivate and provide practice for the students when learning on their own.

SQL Scrolls is an SQL practice game which offers two types of questions: Parson's puzzle^[2] which is used to construct SQL statements and SQL code writing, see Figure 2. The game offers a number of books which either introduce SQL concepts and practice, or offer new game-like topics which support practice in various contexts.

TARGETED ISSUE

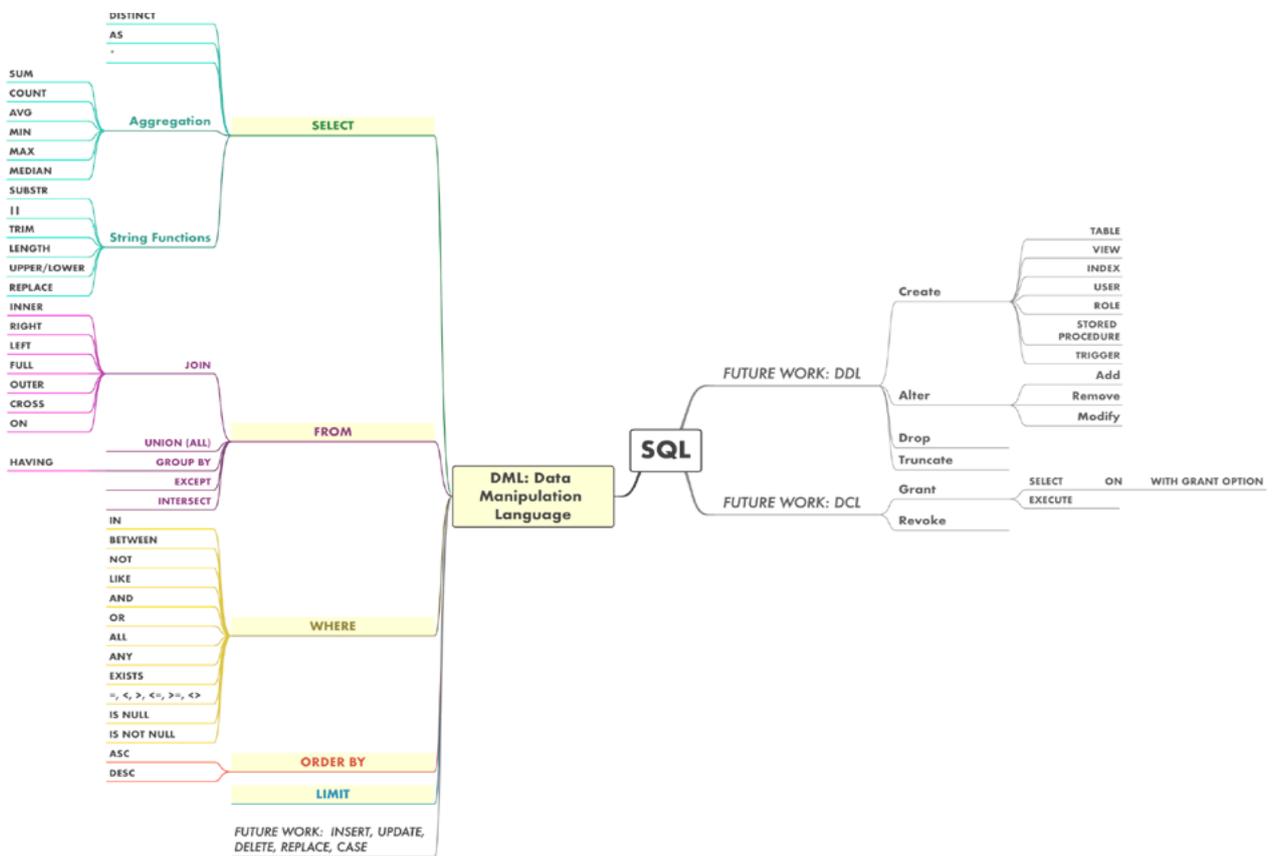
We focus on the following: achieving a full coverage of SQL statements we teach, motivating the students to practice, evaluating usability and usefulness, and understanding the differences, advantages and disadvantages of using a game in comparison to practicing SQL in a workbench. To learn SQL, one needs to write several queries with the same type of SQL construct and a similar solution. Ahadi et al.^[1] have studied seven types of queries which they ordered by difficulty: simple queries on one table, grouping with and without HAVING, natural joins, simple and correlated sub-queries, and self-joins. In our game we offer, for example, a syntactically focused book called "The Art of Grouping" which supports the learning of GROUP BY and HAVING with 7 questions. GROUP BY is shown in Fig 1, as part of FROM statement. Additional practice in grouping is offered by 8 questions in two other thematic books, as in real life the problems to solve are not grouped by query type and the challenge is to find out which way the business problem can be transformed into a query. To practice SQL in context, we offer books with almost real-life stories, such as "Christmas Songs & Spells" which shows Christmas carols that can be joined, using JOIN (Fig 1), with the artist and album. "Zoo Keeper" is about zoo animals, their food, quarters and the keepers who take care of each cage. Both new books were invented by our students and contain problems of varying complexity.

The idea behind SQL Scrolls is to introduce SQL exercises which use a game to motivate and provide practice for the students when learning on their own.



PROPOSED SOLUTION

Our previous experiment with "SQL Scrolls" offering 42 questions showed that students are enthusiastic about "SQL Scrolls" and that the game motivates and is useful for exam revision, see^[4]. However, the first game we tested covered only a small part of SQL and it had one theme: witches and spells. In Figure 1, we highlight what has recently been implemented and show future work. There is still more ground to cover as it needs extensions to the game framework and in the queries. The plan is to deliver 500 SQL practice questions. We will first cover all SQL SELECT statements. The current game includes 99 questions (88 already in use). As our students deliver SQL queries as part of course assignments, we review those gradually and incorporate them. Newest topics include computer games and Pokemon. This has allowed us to construct a new thematic book for simpler queries based on one table and covering most SELECT clauses (top left Fig 1) and listed as the top category in¹. As we develop the game, we classify the SQL statements by difficulty. We focused initially on the SQL Data Manipulation Language (DML) and on the SELECT, FROM, WHERE statements. Extensions to the game framework are being implemented to support DDL (CREATE and other statements) and complete DML with INSERT, UPDATE, and DELETE. We would also like to add Data Control Language which is used for user access control in relational databases.



RELEVANT INNOVATION

The game is much larger in the teaching scope than any of the SQL games we have reviewed^[4]. Existing SQL games can be completed within an hour and do not go beyond 40 questions. The experiment presented in^[1] is based on only 7 queries to be completed in 50 minutes. Our GUI usually allows the learner to answer up to 20 questions in 20 to 45 minutes. With the plan for 500 practice questions, we aim to provide enough practice for the entire SQL part of the database course we described in^[4]. Material generated by our students as part of database assignments needs to be reviewed and reorganised, either technically (by type of SQL expression) or thematically, so as to give a convincing storyline for each exercise. Further additions will include a game certificate and more use of visuals, which are currently limited to colour and a firework when the player submits a correct query. We monitor game use by logging into a MongoDB database and carry out surveys to get feedback on the development.

The game was created by cloning an existing open source game used in teaching, see^[2], and adding new questions. It runs as a Docker image on a school cloud instance.

PROJECT OUTCOMES & RESULTS

The game has already been used by over 100 students, either as part of a class or for individual study. In^[4] we report that student acceptance was very high, 4.43 to 4.7 out of 5 on average, using the dimensions of the ease-of-use, usefulness, attitude towards usage and the behavioural intention to use. We also found out^[4] that DGBL is not inferior to traditional teaching, by administering pre- and posttests. We discovered that our experiment was too long, and the second part failed due to student tiredness. We saw that a game interface allows students to practice faster, but does not teach them to use a workbench, which would need extra time, as a data analyst needs to be able to use a workbench as well.

A recent student survey on the new game (88 SQL questions) with 9 respondents averaged 4.4 for “learning via a game was efficient” and 4.8 for “we played very willingly to learn SQL” and 5 for “we would like to see games in other modules taught in the school”. We also got many suggestions for further game development.

CONCLUSION

We have made a significant step towards making SQL practice fun. Student reactions were extremely positive and the game proved to be useful, as the first version was used by 22 students during exam preparation and the current version is in active use. The game is open source and can be reused by others. The teaching experiment will be repeated in the near future with a new student cohort. The game has a great potential to improve student learning outcomes.



PERSPECTIVES & NEEDS

Our challenges lie in extending the game to deal with the SQL Data Definition Language, and adding further SQL DML statements (UPDATE, INSERT and DELETE). We are preparing experiments that should deliver insights on how to structure at best the game and add further gamification elements, to see if they enhance the learning outcomes and gaming experience. We hope to attract further collaborators to achieve statistically significant results on the educational and usability research questions.

ACKNOWLEDGEMENTS

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6 | CONTRAST OF STUDENTS' EMOTIONAL ENGAGEMENT DURING GAME-BASED LEARNING

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ABSTRACT

This research aims to measure students' perception of their emotional engagement in game-based learning activities and compare them in regard to two types of games: a synoptic board game, Strategious@ which has been created independently by the author and a diagnosis card game which the author adapted for one of the modules he is teaching at the Swiss Hotel Management School of Leysin, Switzerland.

Following a deductive approach within a pragmatic ontology, this is a case study of the Swiss Hotel Management School of Leysin.

Participants filled a questionnaire adapted from the Flow model (Ciszenmihaly, 1990) and the PENS framework (Ichaman, 2016), and cross findings were put in relation with Toda's gamification taxonomy, published in 2019.

The quantitative data collected by closed questions on a 1 to 5 Likert scale was analyzed using general proportions and cross-tabulations. The results showed players felt positive emotions as well as negative emotions with a board game. This was also confirmed by the PENS framework which showed a better experience with the board game. Therefore, for game-based learning activities, serious board games can be qualified as emotional rollercoasters, whereas diagnosis card games can be qualified as emotional icebreakers.

As the cross-analysis revealed that students from generations X and Y accept genuinely more easily game-based learning with synoptic board games than students from generation Z, particular attention needs to be given to generation Z students when introducing such an activity. In regard to students' culture, a greater care and purpose is needed for American students in case of synoptic board games, and for Middle East students in case of diagnosis card games which can be used as icebreakers.

Finally, such game-based learning activities have revealed to be more effective with European students, as they drive their perception to an emotional engagement.

This research was initially part of a Master of Arts' dissertation which structure follows the guidelines of the University of Derby for dissertations at a Master level.

KEYWORDS

Game-based learning; Flow; PENS framework; diagnosis; synoptic.





CONTEXT

This research assessed how participants perceived their emotional engagement during game-based learning activities, focusing on 2 game types. One game was a one-hour board game based on talent management, negotiation and strategic thinking. The second game was a 10-minute diagnosis card game on entrepreneurship, with famous entrepreneurs, their companies, and keywords from the module.

These games have been selected for this research because the author had already included them in one of his modules, called “Entrepreneurship in Events” in the final of the Bachelor of Arts in Hospitality and Events at the Swiss Hotel Management School, and he always wanted to know which type of game students preferred. The research was approved by the DEAN of the Swiss Hotel Management School.

TARGETED ISSUE

This research fits a theoretical framework made from the model of Flow, developed by Csizszenmihaly (1990), which defines eight emotions people feel when confronted to a task. The optimal emotional state has then been defined as the state of Flow. Jessy Schell (2015) further developed this theory by

applying it to game design, saying that in order to keep a player engaged, a good game should constantly adapt the task difficulty to the evolving player’s skills. These 2 authors made a great contribution to the theoretical framework of serious games, but Melker (2015) suggested that more specific comparative researches were still needed to precisely differentiate between types of games. However, even if the theory of Flow, developed by Csizszenmihaly (1990), was thoroughly applied to game design by Schell (2015), it has still never been used to measure players’ emotional engagement when playing a game. Therefore, in the search of an effective measurement, the author decided to associate this theory with the recognized measurement, called the “PENS framework”, as the “Player Experience Need Satisfaction” applied by Ichaman (2016).

This research assessed how participants perceived their emotional engagement during game-based learning activities, focusing on 2 game types.



PROPOSED SOLUTION

There is indeed a clear preference for synoptic board games but these findings also confirmed the importance of having a clear purpose and aim to support the integration of such game-based learning activities and diminish the students’ anxiety, relying more specifically on Mitgutsch and Alvaro’s Game System (2012). Moreover, the warning, given by Toda et al. (2019) about the need of defining a clear purpose to game-based learning, applies more specifically to generation Z students if it concerns a synoptic board game, and more specifically to generation X students in case of a diagnosis card game.

In regard to students’ culture, a greater care and purpose is needed for American students in case of synoptic board games, and for Middle East students in case of diagnosis card games which can be used as icebreakers. Finally, such game-based learning activities have revealed to be more effective with European students, as they drive their perception to an emotional engagement.

RELEVANT INNOVATION

Concerning the tool used to collect relevant data, in the search of an effective measurement, the author decided to associate the theory with a recognised measurement in the name of the PENS framework, as the “Player Experience Need Satisfaction” applied by Ichaman (2016).

Concerning the results of this research, the students showed a general preference for synoptic board games such as Strategious© which was included in this research. Board games produce a greater play experience in game-based learning activities (Hardin et al, 2019; Huang et al., 2019; Nakao, 2019; Sousa 2020). Going deeper, the author found that Autonomy and Relatedness were indeed more important for students when perceiving their emotional engagement when playing the board game than the card game. However, the research also revealed that students in general perceived a greater negative emotional engagement with synoptic board games. Therefore, the researcher qualified game-based learning with a synoptic board game as an emotional rollercoaster with important emotional consequences on both sides. Furthermore, the diagnosis card game is safer although it generates less important emotional reactions from students, so it can be a relevant and safe emotional icebreaker.

Contrasting Students' emotional engagement during game-based learning activities when playing a diagnosis game and a synoptic table game

with students from the Swiss Hotel Management School.

HOW?

The PENS Framework

COMPETENCE

- I feel competent at the game
- I feel very capable and effective when playing
- My ability to play the game is well matched with the game's challenge

AUTONOMY

- The game provides me with interesting options and choices
- The game lets you do interesting things
- I experienced a lot of freedom in the game
- I find the relationships I form in this game fulfilling

RELATEDNESS

- I find the relationships I form in this game important
- I feel close to other players
- When playing the game, I felt transported to another time and place

PRESENCE / IMMERSION

- Exploring the game world feels like taking an actual trip to a new place
- When I accomplished something in the game I experienced genuine pride

(Ishman, 2016)

The Theory of FLOW

Challenge (High) to (Low) 0

Skills (Low) to (High) ∞

Subject mean

Emotional states: Anxiety, Alert, Flow, Attention, Control, Enjoyment, Confident, Relaxation, Boredom, Relaxed, Depressed, Apathy, Distracted, Worry, Stress, Distracted.

(Csizszenmihaly, cited in Arzate and Ramirez Uresti, 2017; Csizszenmihaly M, 1990)

PROJECT OUTCOMES & RESULTS

16

The researcher qualified game-based learning with a synoptic board game as an emotional rollercoaster with important emotional consequences on both sides. Furthermore, the diagnosis card game is safer although it generates less important emotional reactions from students, so it can be a relevant and safe emotional icebreaker.

The cross-analysis revealed that with the board game students from X and Y generations perceived greater positive emotions (Arousal, Flow, Control, Relaxation) than students from generation Z, genuinely accepting more easily this type of game-based learning. However, with a diagnosis card game, students from generation X were the ones perceiving less emotional engagement. The author then saw a confirmation of the idea that each generation has his own socio-psychological perception (Vlada, 2020).

American students were more critical towards the synoptic board game as the results showed 20% of higher negative emotions with this type of game-based learning activity. This contradicts the report of Metaari (2020) which states that the American continent is the first customer of serious games in the world and suggests that Americans would be more used to such activities, also supported by Ferreira et al. (2016).

CONCLUSION

The researcher qualified game-based learning with a synoptic board game as an emotional rollercoaster with important emotional consequences on both sides.

The diagnosis card game is safer although it generates less important emotional reactions from students, so it can be a relevant and safe emotional ice-breaker.

With a diagnosis card game, students from generation X were the ones perceiving less emotional engagement.

American students were more critical towards the synoptic board game.

PERSPECTIVES & NEEDS

As post-graduate students only represent 6% of the sample, we need to extend this research sample in order to reliably conclude and answer the second research sub-question.

A quota sampling is suggested to reach a well-balanced sample regarding the cross-analysis with generations, continents, and pathways.

Moreover, as this research is a case study of the Leysin Swiss Hotel Management School, its results would certainly benefit from an extension of its population.



ACKNOWLEDGEMENTS

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HOW INTERACTION MODALITIES AFFECT SERIOUS GAMES AND EXERGAMES EFFICACY

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ABSTRACT

Human-computer interaction is a fundamental aspect of the new media technologies, specifically for exergames and serious games that exploit virtual/augmented/mixed reality (VR/AR/MR) systems. In the Perception & Interaction Lab (<https://pilab.dibris.unige.it/>), led by Prof. Manuela Chessa and Prof. Fabio Solari, we study how interaction modalities affect both the perception^[1] and the performances of users who enjoy an immersive experience^[2].

Interactions can have a wide range of modalities: we can consider touchful and touchless techniques^{[2][3]}. The former implies that the user handles a device and presses a surface to obtain an action. The latter allows the user to have hands unconstrained. Among touchful devices, we can consider, for instance, mice and keyboards, touchscreen surfaces, controllers, and joysticks. They can have an impact on the game usability and then on its efficacy, also in relation to the user's age or his physical impairment. Touchless technique commonly uses vision-based devices to recognize movements. However, the use of wearable sensors to perform movement measurements is less common. As an important aspect is the visualization device, we consider both standard non-immersive devices, such as the displays of PC and tablet, and immersive ones, such head-mounted displays (HMDs) for VR and MR.

Here, we consider several case studies: simulations for the training in industrial and medical contexts, exergames for student learning and serious games for the cognitive assessment of elderly people.

In^[4] the authors propose a virtual reality ship simulator and the results of an experimental session, in which a maneuvering task was proposed by changing the visualization setup, i.e. a non-immersive system based on standard monitors and an immersive system using a head-mounted display (see Fig.1a). Results show that neither visualization system introduces serious undesired effects or stress and immersive virtual reality systems allow users to feel more involved and present in the simulation scenario.

A simulation for medical students is presented in^[5], where an immersive virtual reality system for first-aid handling is developed. Specifically, the authors increase the visual realism of medical mannequins and the contextualization and add the touch feedback by mapping the real mannequin into its virtual representation (see Fig.1b). Moreover, the interaction is performed by using a virtual representation of the users' own hands by allowing a more realistic execution of tasks. The results show a good accuracy in the mapping between the real and the virtual mannequin, and a high degree of presence for both the control group and the medical one. These results and the low values of simulator sickness reported during the experiment are a good starting point for using the proposed mixed reality system in simulation scenarios.

In^[6], the authors present a VR application for collaborative team building, which was designed for a practice hosted by the University of Genoa (DIBRIS department) during the annual orientation week, dedicated to local high school students. The activity was designed for groups of up to 10 high school students: one person (the VR player) wears a HMD for VR and is immersed in a virtual environment, where some sphere-shaped enemies attack him from every direction. The remaining participants are split into two teams, defenders and attackers: they act by attaching pre-built scripts defining the selected features to a basic enemy Unity prefab. The preliminary results show that it is possible to propagate the high level of engagement, intrinsic to the VR technology, to multiple users, who interact and coordinate with the VR player.

The cognitive assessment of elderly people is presented in [7], where the authors propose two VR applications which take into consideration some cognitive functionalities: memory and attention by using non-immersive VR (i.e. the “Supermarket” test), and reasoning and visual perception by employing immersive VR (i.e. the “Shape-Sorter” test) (see Fig2). The results show that subjects can accomplish the proposed tasks: this is a good starting point for further development of VR approaches, though some work is still necessary to simplify the interaction as well as improve MCI patients’ engagement. Moreover, the results comparison of our proposed VR tests with two standard paper-pencil tests, i.e. the Pfeier and the GPCog, shows a good correlation only with the latter. This requires further investigation, though the obtained results suggest that the proposed approaches can help doctors to assess the cognitive status of elderly people in an objective and automatic way.

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GAMIFICATION TO SUPPORT DATA PROTECTION AWARENESS IN SMALL BUSINESSES

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KEYWORDS

Data Protection; Small businesses; Gamification.

CONTEXT

Data protection is a topic of increasing importance in our today's data-driven economy. It is on the one hand a necessary obligation: The European General Data Protection Regulation (GDPR) has set new standards towards organizations to comply with a strict set of rules. And in Switzerland, a revised data protection law has been announced to become active in 2023. On the other hand, data protection is necessary to keep the customer trust. Data leakage scandals can become a serious issue for the company's reputation.

TARGETED ISSUE

Compliance with data protection regulations is a massive challenge for any organization. It includes new documentation procedures (e.g., a records of data processing activities) and new processes to address data subject rights (e.g., the right to be forgotten). While large corporations possess sufficient resources to establish the necessary tools and procedures, small businesses struggle to cope with the increasing requirements regarding data protection measures. They often lack the budget and the internal knowledge.

PROPOSED SOLUTION

The European Horizon 2020 project named "GEIGER" has been launched to support micro enterprises in becoming better protected against risks in the cyberspace and improve their regulatory compliance. The approach includes building an educational ecosystem incorporating businesses, associations, and apprentices. Among other things, a set of low threshold technical and organizational measures and practical tools is developed for small businesses. This solution offers training modules applying gamification elements on data protection. One example is a data protection literacy quiz, which is based on storytelling to provide learners with concrete and practical examples of data handling in daily business life. Another example is a self-assessment tool, where users are able to check their compliance level. Based on dedicated questions and traffic light results, businesses are nudged to take some quick actions.

RELEVANT INNOVATION

Data protection from the perspective of compliance is an abstract and rather unpopular topic. For example, the GDPR contains 99 articles and more than 150 recitals. The wording of the law text is technical and introduces a variety of special expressions. Employees generally are reluctant to turn to data protection; in particular, in when it comes to the data security topic, fear of acting wrong and causing a security incident is common. Gamified learning elements are useful for this application area in order to reduce fear and support a joyful and motivating experience.

PROJECT OUTCOMES & RESULTS

As found from the testing phase of the “GEIGER” project, it can be concluded that an adapted, modular and low-threshold approach is essential for small businesses with time constraints for trainings. Additionally, a basic data protection awareness has turned out to be essential for practically any employee. Data protection is core and should not be the responsibility of just one single individual in an organization. Instead, a data protection literacy provides an organizational baseline to ensure that any employee dealing with personal data possesses the necessary awareness. Lastly, the gamified learning approach has turned out as an appreciated element to support learning on-the-job.

CONCLUSION

Supporting small businesses on their path to digitalization is an important and challenging exercise for our current world. Any advice for microenterprises has to include not only the chances of digitalization, but also cope with any related risks, such as data protection issues.

PERSPECTIVES & NEEDS

This topic is taking an educational perspective on the needs of small businesses in Europe and, in particular, in Switzerland in relation with data protection basic knowledge.

ACKNOWLEDGEMENTS

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SESSION C HEALTH

THURSDAY, JUNE 30
15:15-15:30

Chessa et Al. proposes a new development Framework targeting the Fitness Gaming Industry. Thanks to their Web/WebGL based approach, the exergames developed with it can run on different kinds of hardware platforms (mobile, VR headset, Laptops). The cloud based architecture also enables acquisition of data and can provide metrics useful for health practitioners. Dominique Correia de Oliveira proposes a Serious Game that simulates the dialogues that a health professional could have with a patient or his family, regarding his legal rights. This platform is used in the education of healthcare Students and differs in methodology from the usual teaching approach of law courses. A 350 participants study is ongoing and results would be provided in another publication.



CHAIR : RENAUD OTT



FABIO SOLARI

A Web-Based Framework for the Management of VR/AR Multi-Platform Exergames



DOMINIQUE C. DE OLIVEIRA

PRITS: A serious game for Law Education

9 | A WEB-BASED FRAMEWORK FOR THE MANAGEMENT OF VR/AR MULTI-PLATFORM EXERGAMES

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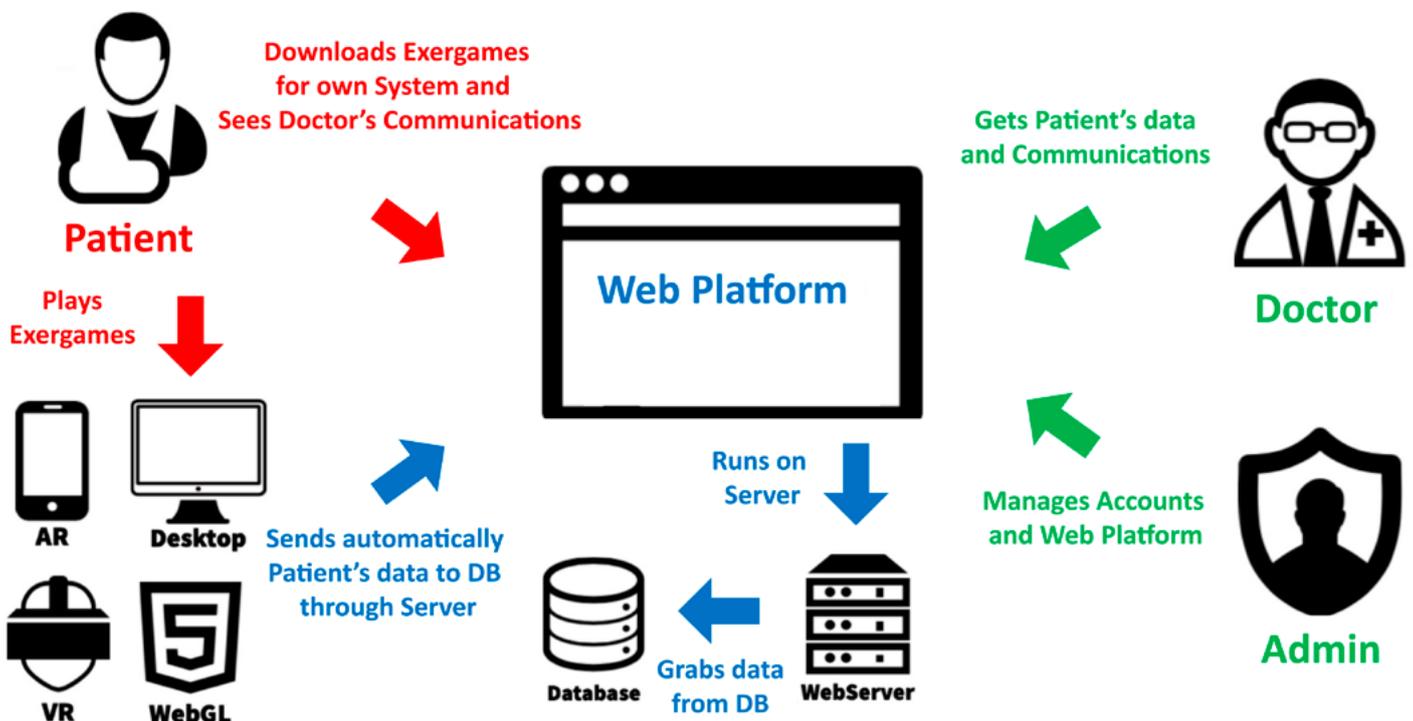
ABSTRACT

In this paper, we propose a web-based framework to deploy multi-platform exergames and gather the user-related behavioral data. Distribution and data collection are crucial aspects to maximally exploit the available technologies. On the one hand, both hardware and software technologies allow the development of tailored exergames which facilitate the patient's activities. On the other hand, doctors can use such exergames to gather rich and continuous data on the patient's status. Specifically, we developed and tested a web-based framework with four multi-platform exergames.

KEYWORDS

Virtual reality; augmented reality; exergames; data collection; tablet; head-mounted displays, WebGL; web-based applications; doctors; patients.

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CONTEXT

In the past, several studies were conducted on medical platforms, which could help both patients and doctors with good results. For instance, such platforms can support education, patient self-reporting, statistic gathering, and patient-doctor communication and monitoring [1, 2, 3]. Using exergames in healthcare can promote motivation and exercise, e.g. for the monitoring and rehabilitation of elderly people [4]. In particular, we are interested in virtual and augmented reality (VR and AR) technologies: VR can improve performance while maintaining the same motion sickness level as a large display [5]. In [6], the authors propose a WebGL VR exergame to assess the cognitive capabilities of elderly people. In general, exergames can be used to complement traditional forms of medical procedures [7].

Unifying web platforms and exergames, which is our paper's aim, improves patient monitoring and patient-doctor communication. It can be an interesting approach, considering current technologies. For instance, in [2] the authors propose an effective implementation of this approach: a web platform provides exergames with the scope of daily fitness exercise and rehabilitation by using a Microsoft Xbox 360 Kinect sensor. Moreover, commercial solutions are also available: e.g., MIRA Rehab (<http://www.mirarehab.com>) and Evolv Rehabilitation (<https://evolvrehab.com>), which can register movements and offer a wide range of exergames targeting different diseases.

TARGETED ISSUE

The design and implementation of a web-based framework, which provides multi-platform (i.e. for different devices and operating systems) exergames and the automatic managing of the patients' data, need handling several issues. We analyzed and tested the most recent hardware and software technologies to make effective applications by using accessible technologies. We wanted to simplify the interaction between doctors and patients by gathering patient's data automatically and make the website more accessible for patients: doctors can easily check the patients' improvement per day and patients have a more enjoyable experience of the rehabilitation exercises, by using a simple setup (after the login, everything is ready and linked to the account).

The framework was developed in the context of Interreg Alcotra projects (i.e. E-Santé/Silver Economy and We-Pro), where we tackled the patients' needs and the doctors' requirements with their early involvement. Moreover, doctors required a custom framework, and we paid specific attention to data security.

Such a framework, which allows doctors to grab statistics online and patients to exercise at home, can be helpful to reduce the global costs, decrease the clinic crowding, and enable reaching patients in rural areas. Moreover, the framework is beneficial in the current Covid-19 pandemic as it avoids physical contact and keeps frail patients at home without requiring them to travel to see the doctor.

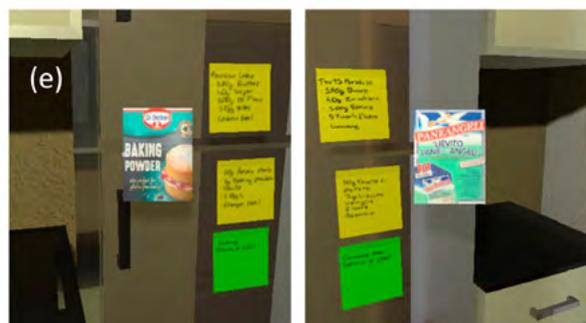
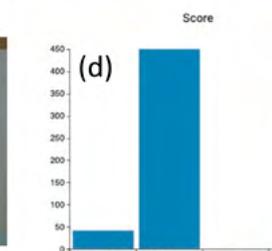
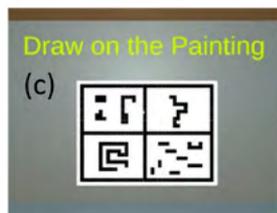
PROPOSED SOLUTION

In this paper, we propose a web-based framework that releases multi-platform exergames and collects automatically and manages patients' data for doctors. The framework's architecture is sketched in Fig. 1.

We chose the Oculus Quest 2 as a VR device, since it does not need any external tracking sensors and has a simple UI just like any Android smartphone. For AR, we tested the exergames on a Samsung Galaxy S10E, iPhone 6S, XS Max, and iPad A. The PC version, which is a conversion from VR/AR to desktop and WebGL interface, was tested on a good laptop, both in Windows and MacOS. For the online platform, local development was tested on a MacOS system using MAMP, and the deployed part on a Google Cloud Compute Engine E2 -micro machine.

The idea behind SQL Scrolls is to introduce SQL exercises which use a game to motivate and provide practice for the students when learning on their own.





We developed the exergames using Unity 3D (2020.3.8f1 LTS), and the following plugins: AR Foundation (with Apple ARKit and Google ARCore) and Oculus XR and we did model assets with Blender and textures with GIMP. All the used software is open source.

The online platform was developed in PHP and HTML (style adjustments in CSS and some JavaScript parts). We also used: Bootstrap 5.0.1, D3 v4, Fontawesome 5.15.3. In the deployment part, which was a test to check if the whole architecture was effectively working when running on a real server, we used NGINX, phpMyAdmin, UFW firewall. Basic PHP security features were used when grabbing user's supplied data and all the sensitive data in the database was encrypted in AES.

RELEVANT INNOVATION

The novelty of our approach is twofold: (i) provide multi-platform exergames that are crucial for the patients' autonomy and decrease overall costs, due to less demand for specific devices; (ii) our framework will be freely available for the community (seldom in the health context). The whole platform was designed considering doctors and patients needs and implemented by following the principles of Interaction Design (IxD).

The web platform was designed to be safe and easy, e.g. users can correct errors that are notified through alerts. The web platform is also accessible to different kinds of users: physical, sensorial, or cognitive limitations can be overcome by using the browser accessibility features.

The idea being to design exergames that can be ported to different platforms, by considering the difference between the use of AR and VR exergames. However, when this is not possible, different exergames that address the same pathological dysfunction are designed in collaboration with the doctors. Thus, every VR exergame has also its AR and standard versions: e.g. in the AR version, the same situation is recreated into the user's mobile device, where the user moves the device camera to change the game view.

Each exergame can produce different patient data: someone has multiple charts, others just one with more information. The framework automatically provides coherent reports. Data and charts were also divided per platform in the patient profile.

PROJECT OUTCOMES & RESULTS

The main web page is composed of a descriptive section, a registration and login part, and a download section, where links to all platforms are provided (Fig. 2a). The Admin account can access a hidden login page. After the login, patients can select the language and download the exergames for their systems. The whole UI is the same for all the devices, by coherently using the different input modalities.

We implemented four exergames of the literature to better focus on their management, both for addressing multi-platform adaptation and different types of patient data. We developed appropriate processing steps to build automatically reports for doctors: Fig. 2d shows an example of a patient performance chart over three days. We describe two games as examples. To train upper limbs, the player is in front of a painting, which must be filled following a specific path (Fig. 2c). For memory and movement training, users take pots, fill them with ingredients, and then cook a cake following the recipe written on post-its (Fig. 2b).

The exergames were tested for all the devices, and we managed to achieve steady 60 fps.



About the multi-language support, the text is in English, then the scenes can be translated into other languages through a script. We have also a script that changes the objects' textures to adapt them to the different languages (Fig. 2e).

The whole platform behaved well with several users using it simultaneously.

CONCLUSION

We developed a web framework that provides multi-platform exergames and automatic reports of patients' data considering the doctors' and patients' needs, and data security. Providing multi-platform exergames allows an enlargement of the patients' population, since they can use their devices at home. The framework enables doctors to obtain automatically coherent patients' data. These aspects can decrease the global cost and improve the patient wellbeing.

PERSPECTIVES & NEEDS

We tested the whole web framework to check its functionalities, now we plan to use it in the field by involving health facilities to do a large user study.

We also plan future improvements regarding security. For instance, at least the implementation of standard DDoS protection and bot protection, for what concerns the registration process, could be carried out.

Implementing even more platforms will be another substantial improvement, such as more different VR headsets and systems.

ACKNOWLEDGEMENTS

This work has been partially supported by the Interreg Alcotra project PRO-SOL We-Pro (n. 4298) and the Interreg Alcotra project CLIP E-Santé/Silver Economy (n. 4793).

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10 | PRITS: A SERIOUS GAME FOR LAW EDUCATION

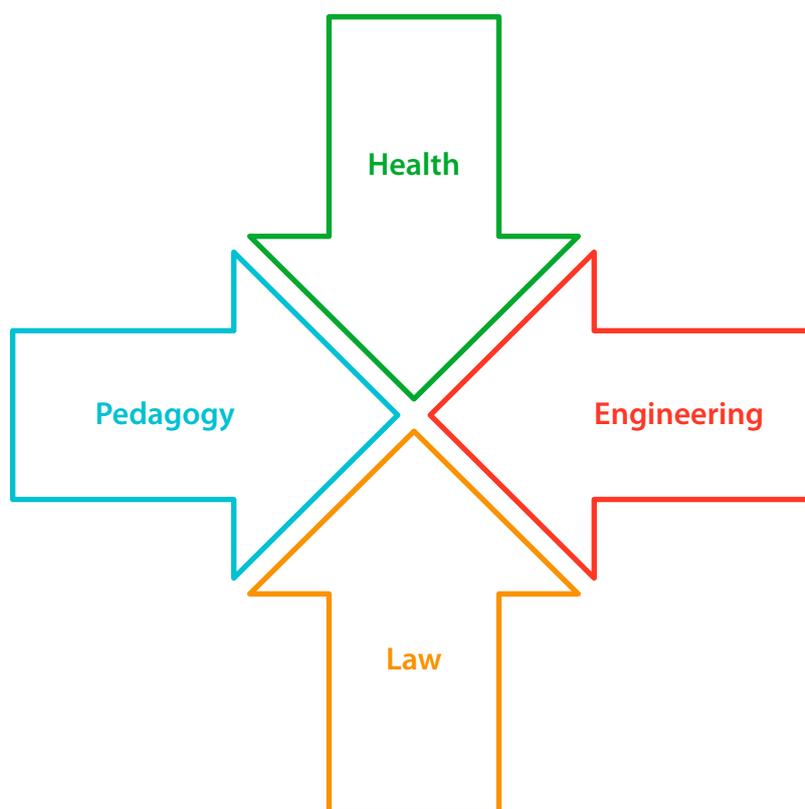
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ABSTRACT

The quality of health care is at a crossroads between medical and legal framework. To support student learning in the field of patients' rights, a multidisciplinary team combining health, law, pedagogy and engineering, has developed a serious game: "Patients' Rights & Innovative Teaching Strategy" (PRITS). Herein the authors establish the links between pedagogy and play, which by their characteristics, can precipitate evolutions towards active pedagogies and the development of soft skills. Associated with an educational scenario, with briefing/debriefing sessions, it encourages participation and achievement of specific knowledge gains. An authoring system allowed the whole team to develop the serious game simultaneously, thus facilitating co-creation. The game was used by 350 students, and we analyzed the results with 3 tools: the French version of the Attrakdiff questionnaire to evaluate the user experience, a translated version of the evaluation of a serious game developed by Fokides et al. 2019 and a questionnaire which assesses student learning. The first results are encouraging with an active student participation and the catalytic role of learning taken by the game.

KEYWORDS

Law Education; Serious Games; Quality of Care; Patients' Rights.





CONTEXT

The COVID-19 pandemic has challenged our health system and shown how intertwined legal and health issues are. The objective of this article is to present the "Patients' Rights & Innovative Teaching Strategy" (PRITS) project, which consists of a serious game whose aim is as much to support students in learning the legal rules applicable in the field of health as to broaden the pedagogical options of teaching law. This tool is the result of a collaboration between the Haute École de Santé Vaud (HESAV) and the Haute École d'Ingénierie et de Gestion du Canton de Vaud (HEIG-VD). The project, which was supported by the digital competence center of the HES-SO as part of its mission of teaching in the digital age, takes shape through a multidisciplinary design and development bringing together several fields, including health, law, education and engineering. (Figure 1)

TARGETED ISSUE

The development of this serious game on patients' rights has three objectives:

1. Encourage the acquisition of new knowledge and the development of practical skills;
2. Assess the feasibility of using digital technologies to support active pedagogies, constructivist and socio-constructivist approaches;
3. Evaluate the potential use of the collected data in the simulation for educational research (acceptance by students, effects on motivation, effects on learning) or professional context (decision making, differences in behavior depending on the education level).

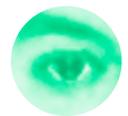
PROPOSED SOLUTION

The PRITS serious game has been developed with the following functionalities:

- › Simulation of dialogues and decision making in different scenarios related to patients' rights
- › Handling multiple patients, dialogues and exercises
- › Instructor interface following up students' progress (Figure 2)

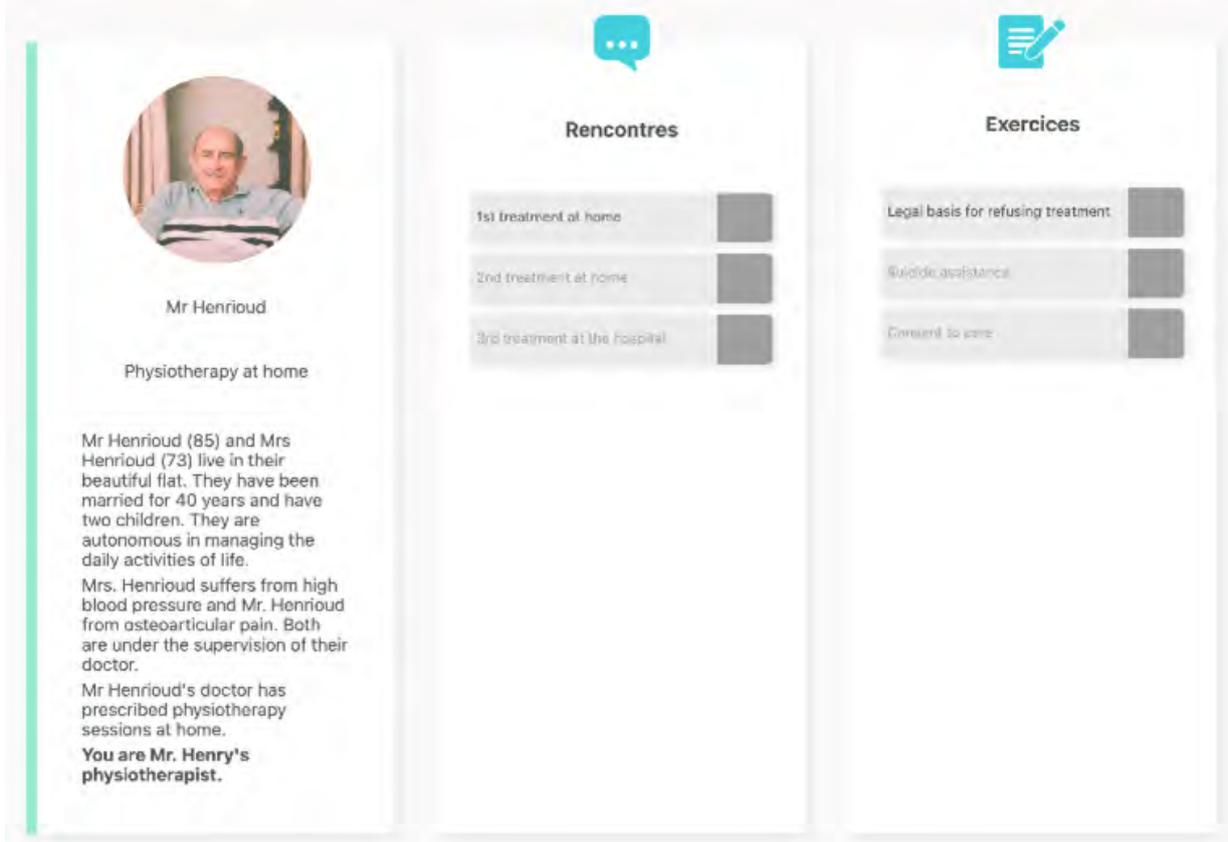
The development of the serious game follows an iterative and co-creative approach. From the start of the project, experts from the health and legal unit of HESAV and AlbaSim (HEIG-VD, Institute of Media Engineering) collaborated on the design and development. The HESAV-AlbaSim team includes lawyers, healthcare professionals, educational engineers, serious game designers, IT specialists, user experience specialists and designers. From a methodological point of view, we use the co-design framework developed by the HEIG-VD team, the co.LAB project. In the PRITS project, the player does not use the game only to learn but he considers learning as a form of play, an active learning which encourages the teaching teams to a profound overhaul of their teaching methods. The fusion of fun and didactics is favored by an approach where designers reflect on a global educational scenario that facilitates the game integration into a broader learning sequence opening onto a training continuum (El Mansouri, 2019).

This stimulating and innovative project is full of challenges for the training of future health professionals [...]



RELEVANT INNOVATION

An authoring system allows the whole team to develop the serious game simultaneously, thus facilitating co-creation. Computer scientists and designers develop the game alongside the lawyers and health professionals who create and input the content. Iterations with user tests and validation by professionals guarantee the development of a solution that meets the needs of students, trainers, professionals and researchers. Patient rights issues are implemented in the game in the form of scenarios transposed into dialogues between a healthcare professional and a patient, and his/her family. The serious game offers interactive narrations and knowledge consolidation exercises. Immersion in simulation takes place in professional situations where the rights of patients must be mobilized, such as when a health professional must inform a patient of the various



consequences of a decision therapy, thus ensuring the patient's right to information. Students will have resources at their disposal to help them in discussions with patients but will also be invited to seek information from the various online resources, in particular by consulting the official websites of the cantons. We provide another vehicle to teach law students and allow them to meet learning outcomes. The innovation of this project is not only centered on the development of serious games but above all on the desire to make the patients' rights topic more accessible to our students through gamification.

PROJECT OUTCOMES & RESULTS

The game was used by 350 students, and we analyzed the results with 3 tools: the French version of the Attrakdiff questionnaire which is a standardized questionnaire to evaluate the user experience, a translated and adapted version of the evaluation of a serious game developed by Fokides et al. 2019 and a questionnaire assessing student learning. We are in the process of analyzing the results but the first data are encouraging with an active students participation where the game favors the questioning between users, and takes a catalytic role of learning. The pedagogical strategy defined by the team aims for the theoretical courses, accompanied by the PRITS game, to allow students to project themselves into situations as close as possible to reality, for the debriefings to contribute to learning, and the transfer of knowledge to other situations.

CONCLUSION

This stimulating and innovative project is full of challenges for the training of future health professionals, especially with the current health situation where the exercise of health professions is put to the test today by COVID-19 and its impacts. The therapeutic relationship between the different healthcare professionals and the patients raises questions, particularly legal ones, which the professionals, through their activity and duties, are required to recognize and respect.

PERSPECTIVES & NEEDS

The purely theoretical teaching of law courses has been privileged for many years. However, projects and initiatives are booming for the development of education in the digital era, in particular to meet the various challenges of our society. Depending on the evaluation results, the authors wish to expand the use of serious games for teaching and learning purposes to students from other schools, to professionals, health graduates or patients.



ACKNOWLEDGEMENTS

The digital skills center of the HES-SO (CCN) supports the PRITS project. PGBDS8-104294 The Support of the management and the research department of HESAV

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NATURAL LANGUAGE INTERACTION FOR GAMES AND GAMIFICATION

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KEYWORDS

Game Design; Natural Language Interaction; Narrative; Conversation; Storytelling.

ABSTRACT

Recent technological advances have made talking “naturally” with fictional characters not only possible but even accessible to small scale projects. This form of conversational interaction affords new type of experiences relevant to games in general but also to gamification applications that have been surprisingly underexplored. In this paper we briefly describe design problems arising from this approach and propose heuristics for their resolution. We also discuss the specific affordances and value brought forward by playful natural language conversation with game characters. This knowledge is informed by the actual design and development of a number of conversational games by the LabLabLab.

CONTEXT

Conversing with fictional characters (often referred to as non-playing characters or NPCs) is a common and important feature of digital games. NPC dialogue can accomplish multiple functions: it is an engaging and interactive means to deliver information on the game world, provide objectives to players, give feedback on progress, etc. Dialogue can even part of the game’s challenge if the player needs to skillfully navigate the conversation to obtain something from the character.

A key appeal of games is the agency afforded in the resolution of objectives. Players have to experiment with the mechanics, strategize, formulate plans and deliver performances to achieve their goals. When it comes to conversations, however, this agency is still mostly limited to choosing amongst a very limited number of pre-written lines, leading to pre-written answers and ultimately amounts to navigating canned flowchart. This dominant approach (often referred to as “dialogue tree”) is simple to implement and author, and is often “good enough”. However, it leaves very little space for players to creatively and playfully engage with fictional characters.

The past decade has seen a steady development of technologies for natural language interaction. A large portion of the public has now had the experience of talking to conversational agents such as Siri, Google Assistant or Alexa—often just for fun. It is surprising that yet very few digital games have attempted to harness this potential for new for

TARGETED ISSUE

Interacting with fictional characters in natural language raises new design and authoring questions.

1. How do you motivate players to “talk” to fictional characters?

Natural language interaction allows more freedom to players but also requires more effort. Clicking on menu item is simple and does not even require reading the text.

2. How can a conversation be a game and how do you design such a game?

The traditional repertoire of video games objectives such as scoring points, arriving first, eliminating an opponent, navigating a dangerous landscape, etc. do not provide much examples on how to frame a conversation as a game. What would players have to do and what means would they have to achieve their goals?

3. How do you manage communication errors?

When players have to choose between a menu of options, designers have full control on the scope of input they will have to respond to. Natural language inputs, however, can take an extremely large variety of forms. Many problems can arise from this: the system might not have any answer ready for a specific player intention or, there might be one but it fails to recognize that intent.

4. What is this good for?

What new qualities of experience can be expected of natural language-interaction with fictional characters? And, in the context of gamification, what new applications can this be relevant for?

Proposed solution

The LabLabLab has designed and developed a number of experimental, research-creation games in the past decade to explore the affordances and opportunities of both natural language input and natural-language generation for interaction with fictional characters and virtual worlds. In the process, we have developed a series of design heuristics to approach the problems stated earlier.

Motivation:

As with other games, players can be motivated to engage meaningfully with virtual characters when provided with an objective and given a clear role in the proposed fiction.

Conversational Game Design :

A useful reference for goal-oriented conversation is that of argumentation. Dessalles proposes a simple model in which an argumentative conversation arise from conflicts between the beliefs and desires of the two characters. The objective is then to change these beliefs and desires so that they can be in adequation. In this context, players can perform “conversational moves” in the form of arguments that will contribute to changing the mind of their interlocutor.

Error management:

In natural-language interaction, communication errors *will* happen. Therefore, they have to be designed for. Useful approaches include what Janet Murray names “scripting the interactor”, that is conveying clearly to players how to “play along” in order for things to be fun and managing expectations as to the limits of the system. At a lower level, NPC responses can gently steer the player towards the topics th

RELEVANT INNOVATION

Conversational natural-language games can be used in any situation of interaction with a fictional character. However, in the context of gamification, we can speculate on some particular applications.

Communication:

Characters can act as interfaces to knowledge bases (or worlds), allowing players to freely discover things through questions, or become aware of the character’s subjective take on things. This can be spiced up by playful banter or even resistance from characters which can increase the value of the retrieved information (as in our SimHamlet game).

Education:

These games can be playful second language teaching applications, practicing players’ ability to read and write. The characters can be programmed to recognize and comment on common mistakes.

Therapy:

Conversational games can be opportunities for socially anxious players to practice human interactions in a safe context. The free input can also allow players to share difficult personal narratives as if talking to someone while retaining complete privacy.

Data collection and citizen science:

Since these games prompt players to input freeform content, they can be used as playful methods of surveying and data gathering (given players are aware and in a position to consent to this).

PROJECT OUTCOMES & RESULTS

In the last decade, the LabLabLab has designed and developed six games leveraging natural language input, generation or both. They can all be played freely here https://www.lablablab.net/?page_id=9 and one can make their mind as to the soundness and validity of the different approaches experimented.

This research-creation process has also led to a number of scientific papers which can be found here: https://www.lablablab.net/?page_id=7. The most relevant ones can be found in the reference section.

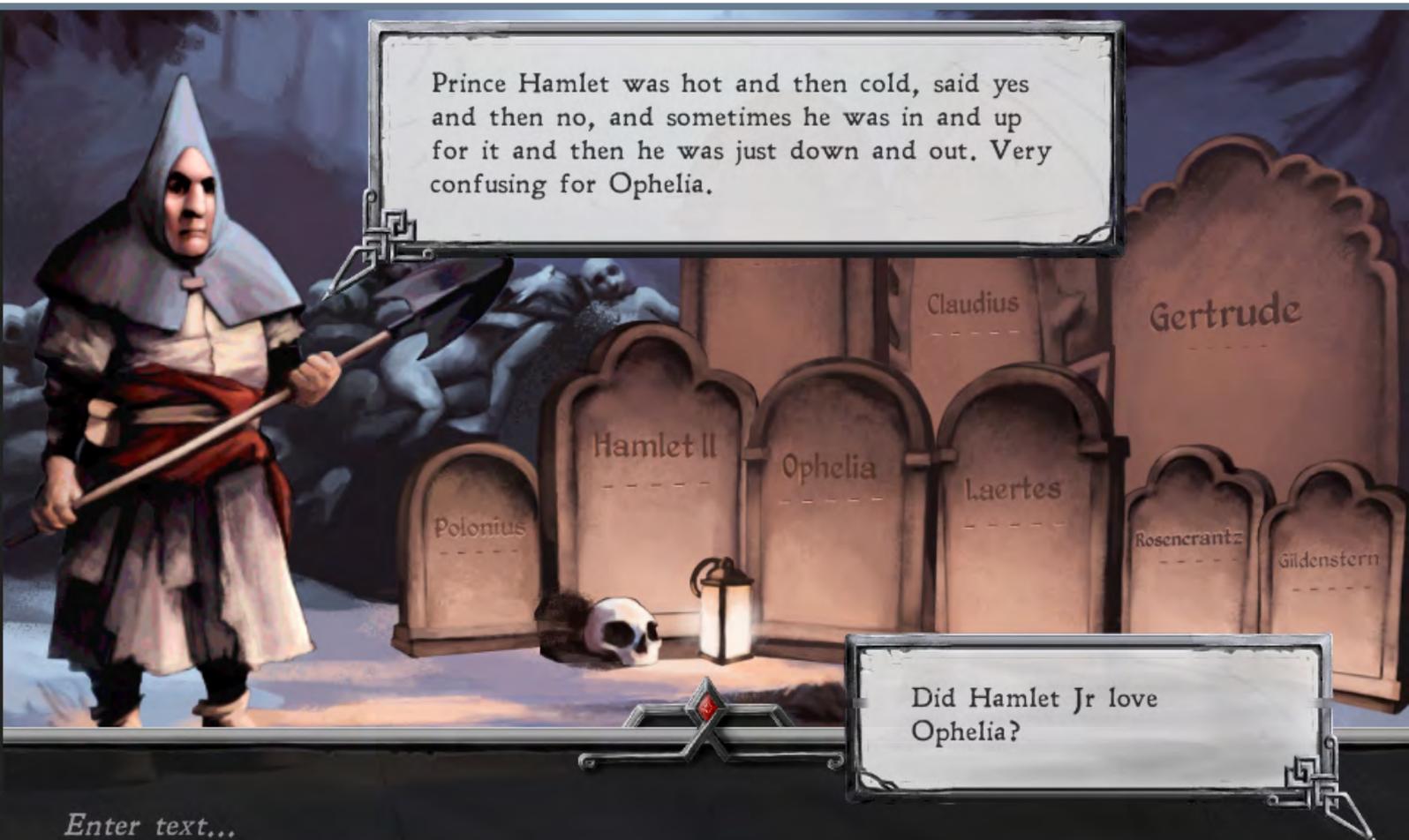
CONCLUSION

Recent technological advances have made talking “naturally” with fictional characters not only possible but even accessible to small scale projects. This form of conversational interaction affords new type of experiences relevant to games in general but also gamification applications that have been surprisingly underexplored. The LabLabLab games represent a series of experiments both in the technical implementation of such projects but more importantly in the exploration of this new design space

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PERSPECTIVES & NEEDS

This approach is still under-explored both in entertainment games and gamified applications. Future projects will continue mapping this design space and help provide know-how and good practices.



ACKNOWLEDGEMENT

This research was made possible by the Fonds de Recherche du Québec - Société et Culture.

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SESSION D TRAINING

FRIDAY, JULY 1
09:30-10:50

Education and training are best domains where gamification and serious gaming are highly adapted. They can help children, students and apprentices to increase their skills and capabilities in different contexts. This will be demonstrated in this « Education & Training » session through three short papers. In the first, authors will present us dynamilis, an application to helps 5-12 year old children to improve their handwriting. In the second paper, authors will talk about codificio 2.0, an application designed to train medical students in the codification of the ICD-10 diagnosis and semiology. Finally, in the last paper, authors will present a VR simulator training for teenagers with intellectual disabilities.



CHAIR : STEPHANE MALANDAIN



JOHAN JAQUET

Virtual Escape Game as part of a Bachelor's and Master's degree finance course



THIBAUT ASSELBORN

Dynamilis: the app that helps 5-12-year-old children improve their handwriting



ARIEL CORTES

APP CODIFICIO 2.0



MARINE CAPALLERA

Virtual Reality Simulator Training for Teenagers with Intellectual Disabilities

13 | VIRTUAL ESCAPE GAME AS PART OF A BACHELOR'S AND MASTER'S DEGREE FINANCE COURSE

Fabien Degoumois¹, Jocelyne Majo², Olga Kasatkina¹, Perrine Leroy²

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2: HEIG-VD, School of Engineering and Management Canton de Vaud, Yverdon-les-Bains, Switzerland

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SUMMARY

Starting from the competences of students, who, in their private sphere, mobilize social networks and the Internet as personal resources, this project aims at transferring their digital practices to the resolution of professional issues through the development of their capacity of self- and peer learning. The creation of a virtual and collaborative escape game intends to enhance self- and peer learning by providing a framework for the deployment of these digital practices in a systematic way.

The project aims to digitalize an existing teaching method in the form of an escape game where each learning step is self-evaluated by the learner or group of learners. In a second step, a study of the approach relevance will be carried out in order to identify the means and the so-called "classical or digital" tools to promote and accelerate autonomous learning.

KEYWORDS

Escape game; exam revision; collaborative learning.

Virtual Escape Game as part of a Bachelor's and Master's degree finance course



14 | DYNAMILIS: THE APP THAT HELPS 5-12-YEAR-OLD CHILDREN IMPROVE THEIR HANDWRITING

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SUMMARY

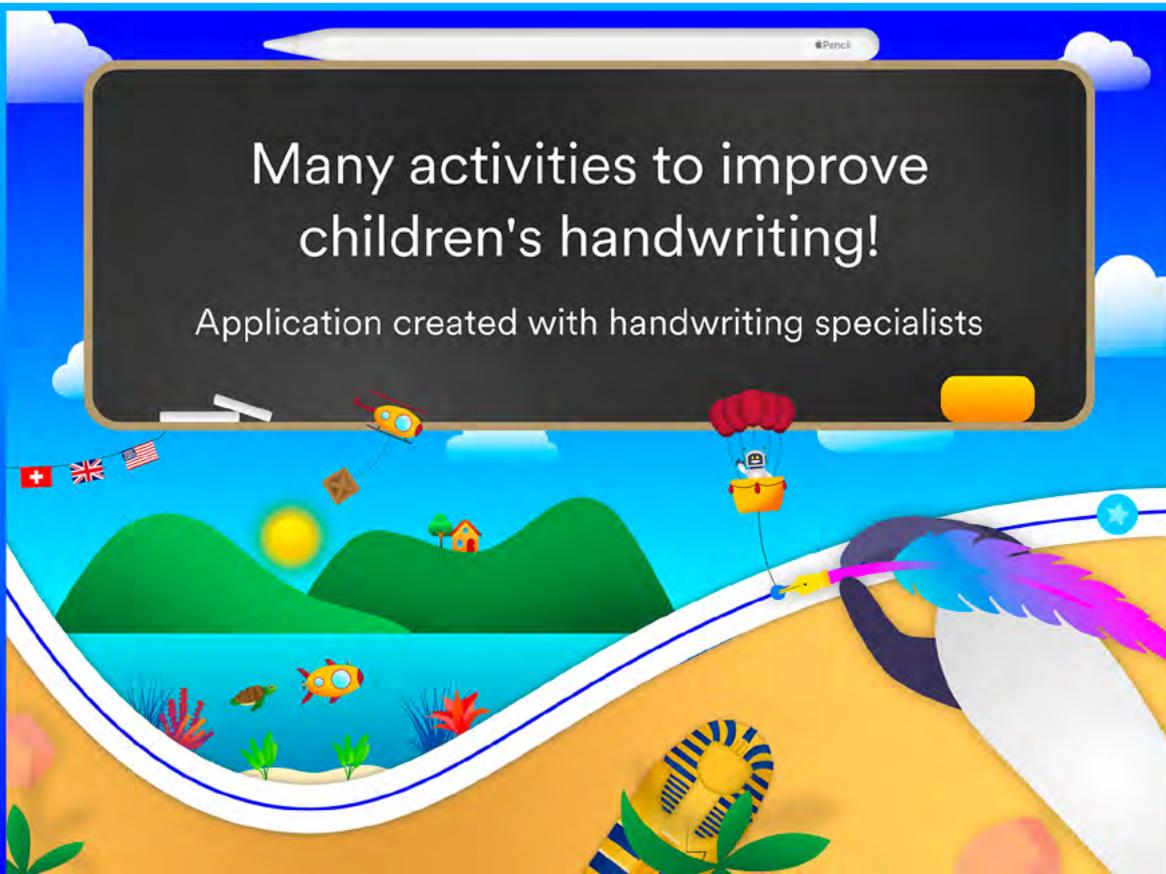
Born in an educational lab at EPFL, “Dynamilis” (www.dynamilis.com) has been developed in close collaboration with handwriting specialists and teachers. It helps 5-to-12-year-old children facing handwriting issues as well as those learning how to write. Dynamilis leans on several years of academic research published in top international scientific journals including Nature Digital Medicine and Nature Scientific reports. It can be installed on iPads and needs an apple pencil to work. The app can be broken into two distinct interconnected modules: the analysis and the remediation modules.

The analysis module: With no more than 30 seconds of handwriting, we can extract the child’s complete handwriting profile. Our analysis divides handwriting into four fundamental parts (static, speed, pressure and tilt). For each category, a score between 0 and 100 exposes the child’s handwriting quality.

The remediation module: We co-designed 10 handwriting activities training specific aspects of handwriting (e.g. pressure control, finger dexterity, precision, ...). These activities are recommended on the basis of the specific child’s weaknesses spotted during the analysis.

KEYWORDS

Handwriting; Analysis; Remediation; Dysgraphia; Education.



15 | APP CODIFICO 2.0

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SUMMARY

Objective: “APP CODIFICO version 2.0”, serious game, that has been designed to train medical students in the codification of the ICD-10 diagnosis and semiology. The main purpose of the version 2.0 of the “APP CODIFICO” is the practical learning of diagnostic coding in medicine using the International Classification System for Diseases and Health-related Problems in its version 10 (ICD-10) currently in force in the country (Colombia), through a gamified teaching strategy.

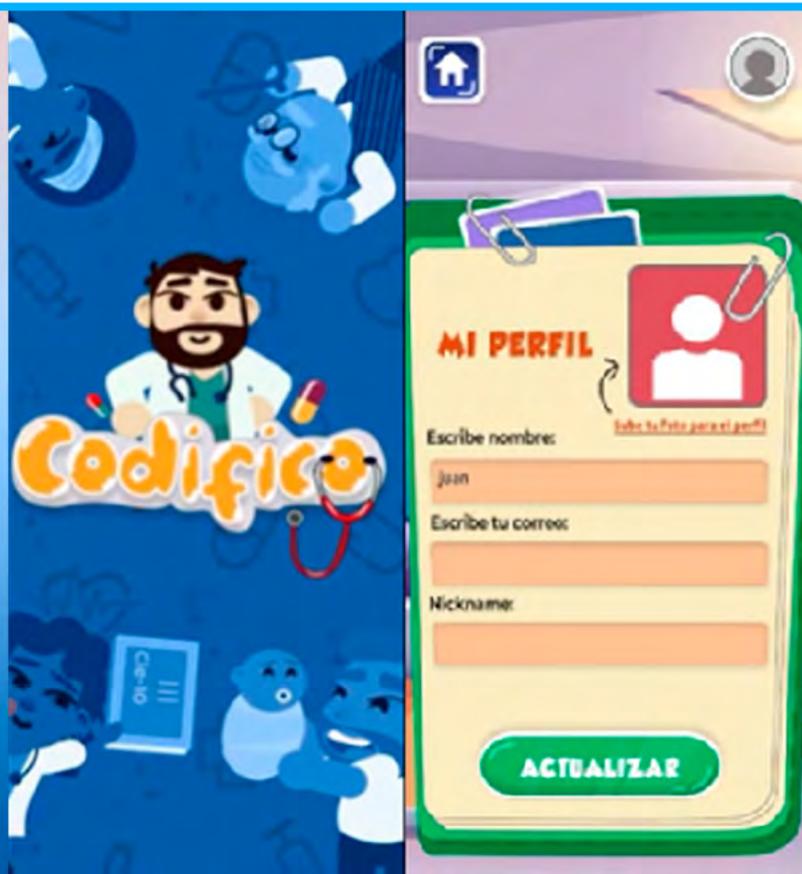
Materials and methods:

We intend to evaluate the capacity of medical health personnel to carry out diagnostic processes when applying diagnostic and semiological classification systems. To do this research, we used evaluation instruments such as clinical cases of different complexity degrees as well as areas of expertise. The comparative results were analyzed to evaluate the impact on the learning process when using this strategy type

Call: we are making a call to get participants in the project and for the English application extension in different countries.

KEYWORDS

Serious games; Medical education; Clinical coding; International Classification of Diseases; Learning.



16 | VIRTUAL REALITY SIMULATOR TRAINING FOR TEENAGERS WITH INTELLECTUAL DISABILITIES

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SUMMARY

People with intellectual disabilities (ID) need to train regularly to perform several complex daily tasks while being accompanied by one or more supervisors. The use of virtual reality (VR) allows the simulation of these learning situations that would be difficult to set up or reproduce systematically in the real world. This paper presents an enhancement to a VR simulator designed for this purpose with the help of social educators. The goal is to use virtual reality to perform learning exercises with teenagers with ID. The main exercises are: (a) walking on the sidewalk and crossing crosswalks, (b) taking one or more buses and getting off at the right stops, (c) taking the right train at the station and getting off at the right stop. The simulation also proposes to manage social interactions thanks to the use of avatars in these scenarios. Each scenario is customized for the students' learning objectives.

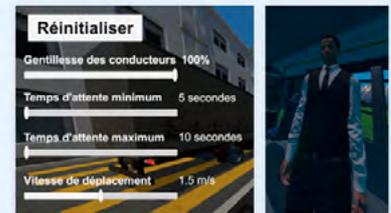
KEYWORDS

Virtual reality; Intellectual disability; Simulator Training.



Street and crosswalks

- Unforeseen
- Obstacles
- Pedestrians
- Protected (red lights) or unprotected



Example of customization and avatar (social interaction)

Bus

- Bus scenario (get off, get on)
- Stop (with or without contingencies)
- Artificial voice to announce stops and problems
- Social interactions



Train and station

- Train scenario (get off, get on)
- Station (with or without contingencies)
- Artificial voice to announce stops and problems
- Social interactions



SESSION E ART, CULTURE, TOURISM & ARCHITECTURE

FRIDAY, JULY 1

10:50-11:35

In this session you will discover three completely different and fascinating games offering experiences that raise awareness about the realities of our world and the challenges that must be overcome in our quest to make it a more sustainable place.



CHAIR : FLAVIO ROTH



JANINA WOODS

Sarnetz: Raising awareness about CO² neutrality in a collaborative serious game



ELIANE ZIHLMANN

“BATVISION” Experiential Learning through Virtual Reality



MATHIS EBNER

“The Thief of Homburg”, a game combining archeology with modern game design to convey Swiss cultural sites



17 | SARNETZ: RAISING AWARENESS ABOUT CO₂ NEUTRALITY IN A COLLABORATIVE SERIOUS GAME

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ABSTRACT

While almost everyone has heard of the term “CO₂ neutral”, it is often hard to imagine what this means for towns and cities. The difficulty includes not only knowledge of the measures that can be taken to achieve this goal, but also the challenges of implementing them in a real-world environment with many different stakeholders. The Sarnetz game introduces players to the technical solutions for CO₂ neutrality and lets them decide collaboratively which measures to implement.

KEYWORDS

Serious Game; learning; awareness; CO₂ reduction; climate change; sustainability; energy.

Sarnetz

Raising awareness about CO₂ neutrality in a collaborative serious game

Background Based on “Zernez Energia 2020” research project by ETH Zurich investigating how to sustainably reach zero carbon emissions in Zernez region.

The Game Digital version of existing physical board game enabling remote play via Unity WebGL build and external video chat solution.

Goals Raise awareness about the complexity of reaching zero carbon emission while satisfying various stakeholders and balancing different technological measures for energy and heat production and distribution.

Gameplay Players propose different measures on map of Zernez in order to:
 (1) lower carbon emissions
 (2) increase local energy production
 (3) balance financial spending
 Players take on roles of different stakeholders and argue for or against proposals depending on their individual perspectives to reach consensus.



CONTEXT

The online game “Sarnetz” [1] is based on a physical board game [2] originally developed as part of “Zernez ENERGIA 2020” by an interdisciplinary research team of the Swiss Federal Institute of Technology in Zurich, together with private partners and the local authority. “Zernez ENERGIA 2020” is a plan for the village of Zernez to become CO₂ neutral by 2020 [3]. It proposes a variety of measures which authorities and the inhabitants can take to achieve the goal together. The board game was based on the results of the studies by ETH Zurich, which in turn forms the basis for the digital version of the game called Sarnetz.

It was decided to adapt the game into a digital version, so it can be available as an educational tool for a broader audience. This resulted in a version which can be played in groups despite the ongoing pandemic. The board game has been played in workshops hosted by HSLU since 2016 and thanks to the digital version these workshops continued with an online audience. Besides teaching and raising awareness, the game has the added benefit of promoting the village of Zernez internationally.

TARGETED ISSUE

The game tackles several main issues around the problems of upgrading a town to become CO₂ neutral. Most importantly: Every plan needs to consider the citizens living in the town. The core gameplay puts these issues at the forefront and challenges players to find the “best” solutions in order to obtain victory.

These main issues include (but are not limited to):

- (1) What specific measures can be taken in a village to achieve CO₂ neutrality and 100% locally produced energy, while taking into consideration financial cost? For example: What are the types of heating and energy production available? How do they work together? What effects do they have on climate change?
- (2) What are successful broader strategies to tackle CO₂ reduction considering the small impact of individual measures?
- (3) Who are the different stakeholders in these issues and how do their perspectives and demands differ? How can a consensual solution be reached to satisfy all of them?

PROPOSED SOLUTION

In Sarnetz, two groups of 5 players each compete to see who can create the best solution for a “carbon free” village of Zernez. The group’s performance is measured by three metrics: (1) reduction of CO₂ emissions; (2) production of local energy; (3) financial cost. Players can choose between different measures to reach these goals. These include, but are not limited to, construction of free-standing photovoltaic panels, renovating old building envelopes, or constructing a network of district heating pipes. The costs and impacts are portrayed as close as possible to the real world, so that building a strategy based on the metrics is also relevant outside of the game.

During the game, each player takes on the role of a different stakeholder involved in the issues: CO₂ Manager (responsible for reducing CO₂ emissions), Energy Manager (responsible for producing energy locally), Finance Manager (responsible for keeping expenses low), Citizen Representative (arguing for the wishes of the citizens of Zernez) and Energy Supplier (responsible for selling oil to Zernez). Players need to take into consideration the personal goals of their role when considering measures. A moderator triggers votes that need to be unanimous to be implemented.

To strengthen the link to the actual village of Zernez, the game map is based on the actual topology and property borders. The visual design of the buildings is based on traditional Eastern Swiss houses.

[Sarnetz] proposes a variety of measures which authorities and inhabitants can take to achieve the goal together.



RELEVANT INNOVATION

The biggest strength of the physical board game consists of the discussions that arise from having to argue for (or against) certain measures from the perspective of the different roles. Designing a collaborative serious



game is already a challenge ^[4] and a non-co-located online version risks making discussions more difficult. To counter this, we deployed different measures:

- › An external video call solution, which allows us to benefit from a reliable and tested system known to most if not all players. Furthermore, it allows players to flexibly switch between the game and the video chat view according to their personal preferences.
- › A strengthened moderator role: The moderator is responsible for triggering formal votes on any proposal. This helps to structure the rather free-form discussions of the physical board game by providing clear phases for going from proposal to implementation.
- › Basic gestures: The cursors of all players are visible for everyone (represented by a large, person shaped game piece, which moves across the map). This allows players to indicate their interest in specific areas on the map or proposed measures – a simplified version of pointing at various elements of the board game version in real life.
- › Automation: The physical board game required a lot of manual bookkeeping from the players, so-called chores ^[5], which are automatized in “Sarnetz” This was often overwhelming for players, especially when comparing the effect of different measures. Manual bookkeeping is also prone to error.

PROJECT OUTCOMES & RESULTS

We developed “Sarnetz” in Unity to be played in a browser via WebGL with a group of players. The game was played in online workshops with Japanese university students of 5-7 player groups, as well as in workshops with Swiss middle-school students of 6-10 player groups. In case of there being more players than roles, 2 players shared certain roles and discussed together. Two groups always played in parallel in competition. The discussion was mainly led by the participants themselves, with a moderator in each group giving hints and asking questions when they got stuck.

The workshops were structured like this:

- › Introduction of the topic
- › How to play the game
- › Play in groups to achieve the game’s goals through discussion
- › Presentation of results and reasoning by each group
- › Assessment of results by the moderators
- › Explanation of real-world solutions used in the actual village of Zerne



After the workshops, the participants gave written feedback by answering questionnaires. The results of these and future workshops will be the basis for an in-depth qualitative study about the effectiveness of achieving a learning effect and awareness about the topics.

CONCLUSION

The workshops showed that the players retained knowledge and awareness on the topics mostly thanks to their own role and listening to the other's arguments. Some mentioned that they considered the Citizen Representative role the most valuable to retain a link to the actual town. The different stakeholders' viewpoints made the discussion around the issue relatable and closer to real life which helped the participants to retain information better and come to surprising leanings.

PERSPECTIVES & NEEDS

Going forward we plan to improve the usability aspects of the game to make it easier to play and more accessible. We also want to adapt the concept to villages and cities in different areas and climates, as the measures to tackle CO2 reduction differs greatly depending on where the game takes place. This would allow players to experience local issues and solutions and thus potentially generating greater interest and impact.

ACKNOWLEDGEMENTS

We would like to thank the Science and Technology Office Tokyo, Swissnex, HSLU, IC Spatial Development and Social Cohesion, ETH Zurich, the village of Zerne, all players and especially the moderators for supporting Sarnetz.

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18 | "BATVISION" EXPERIENTIAL LEARNING THROUGH VIRTUAL REALITY

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ABSTRACT

This paper discusses the evaluation phase based on six pilot projects with clients for a Swiss VR project called "BATVISION". The project's goal is to improve content delivery to participants through designed knowledge transfer and immersive technologies. The result is a prototype that has been tested in six locations. Further on, the prototype will be optimized for specific exhibition sites to deliver a market-ready solution. Next, the application will be explored for more advanced target groups in order to further develop an application beyond the exhibition context.

KEYWORDS

Edutainment; Experiential Learning; Immersive Media; Game Design; Biomimicry; Technology; VR; Knowledge Transfer; Gamification.

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BATVISION

Discover life from
a bats perspective





CONTEXT

In 2015, the United Nations unanimously agreed on 17 Sustainable Development Goals (SDGs), which are part of the 2030 Agenda for Sustainable Development, but social, cultural, and environmental problems still seem to be progressing worldwide (such as climate change, destruction of habitats, extinction of species). People are still not sufficiently aware of these issues, cannot understand, imagine or relate to them, and therefore, will not change them either. Digital technologies such as Virtual Reality (VR) allow a wide range of people to experience abstract content appealingly. However, apart from the technological teething troubles, the available content is not yet fully exploited in terms of experiential design. ^[1] At the same time, we know that people can better understand and focus through a self-made bodily experience. ^[2]

TARGETED ISSUE

How can a bat sensory apparatus be better explained and made accessible to a broad audience? How can we effectively affect people and motivate them for important topics in a positive way? How can learning topics be made

more attractive and playful? To answer these questions, Eliane Zihlmann and Raffaele Grosjean (Z&G), from the Department of Industrial Design at the Zurich University of the Arts (ZHdK), developed the bachelor thesis called “BATVISION” in collaboration with Immersive Art Space Zurich (IAS) and the Stiftung Fledermausschutz Schweiz (SFS) ^[3]. After the bachelor, Z&G developed the project further and got financial support with the overarching project “Somebodyelse” ^[4] from February 2021 to December 2022 as part of the “First-Ventures” program of the Gebert Rüt Foundation. After the development phase in the first half of 2021, the “Somebodyelse” project team evaluated their applications in the second half of 2021 and developed further scenarios of Embodied Experiences in addition to “BATVISION”. This paper focuses on the evaluation phase of the pilot “BATVISION” project from July to December 2021.

BATVISION is a VR experience that allows the user to embody a bat and experience the world from its unique perspective.



PROPOSED SOLUTION

In the first phase from February to June 2021, the “BATVISION” prototype was developed into a testable version. In this phase, internal user tests were carried out, mainly in collaboration with the Swiss Bat Protection Foundation. After this development phase, “BATVISION” was evaluated in the following scenarios:

The first test case took place at the Neuchatel Film Festival. During 10 days, the experience was tested in a museum, focusing on the experience handling from the various support staff. The experience was also tested outdoors, evaluating the light sensors viability in different light conditions. The next case took place at the research department for children rehabilitation in the children's hospital of Zurich, where we examined an adapted version of “BATVISION”. The aim was to trigger the subjects' motivation to move. Subsequently, “BATVISION” was tested at Scientifica, with Dr. Hiloko Kato's help, using the conversation analysis method. The test subjects were filmed by several cameras while they took part in the VR experience. Around 100 bat researchers, including people over 60, had the opportunity to try the experience at the National Research Conference for Bats. At last, as part of an event under the direction of Naturama Aarau, we experimented the implementation of rapid 5-minute use and the parallel use of several headsets with groups of 15 children at a time.

RELEVANT INNOVATION

“BATVISION” is a VR experience that allows the user to embody a bat and experience the world from its unique perspective. This works as follows: When the user starts the experience, everything is in the dark. The user can only start orienting him/herself by shouting, which causes a simulated soundwave to emanate from the user and light up the environment and is a way to mimic a bat's sense of echolocation. Thus, our experience allows a playful exploration of how a foreign body perceives the world. In the storyline, we specifically draw attention to bats' gradual extinction due to habitat restrictions in urban space.

In “BATVISION”, the goal was to create an immersive world and awaken empathy by embodying a living being and therefore draw attention to noise pollution and the dwindling of animal habitats in urban areas. By applying research through design, the team investigates the achieved immersion degree in virtual experiences;



the aim being to explore the design means to increase immersion and thereby obtain a stronger effect. It uses the microphone input for the primary scream interaction but applies it unconventionally since it is the only way to navigate. All the interactions are designed to be intuitive aiming the increase of the experience impact on human emotions and learning capabilities.

PROJECT OUTCOMES & RESULTS

Each age group consistently and very highly accepted the VR experience. In terms of content, the experience was rated by numerous bat experts as a motivating and appealing way of conveying content. The entertainment aspect was extremely appreciated and often perceived as a motivation to dive more deeply into something. Using Virtual Reality still seems to be a challenge for potential users to implement at their venue. Many users do not yet understand the medium and visitors need to be guided by an attendant. Results show that when the using barriers are taken down, accepting the technology is no longer a problem. As it is important that the experience is flexible in terms of time, we implemented for group demonstrations, a time control feature. In order to do further research to use “BATVISION” in projects in the motivational rehabilitation field, it is particularly important to define which specific goal will be pursued, which is to be further evaluated in the course of the project. It was found that older people (60+) were particularly fascinated and amazed by the experience. As a conclusion to the test results, the development of “BATVISION” continues to focus on users from the entertainment and culture segment.

CONCLUSION

During Scientifica, 28 people filled in a survey and first results show that people in general were highly entertained and comfortable. 67.9% confirmed that they would like to use “BATVISION” again, 14.9% of which would visit a place especially designed for this purpose. Although the idea of developing empathy towards an alien being and a change in consciousness is difficult to verify, most participants found that they learned something about bats and rated the result with 8.5/10 points.

PERSPECTIVES & NEEDS

The project goals are to create an interactive and multimodal experience to mediate educational content while allowing an intuitive handling. The experience is now being developed for market readiness in museums, events and group excursions. “BATVISION” will be available in various Swiss museums from spring 2022 [5]. Based on the user experience research, we will further explore this advanced prototype potential to set the base for future use cases in different fields.



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19 | "THE THIEF OF HOMBURG", A GAME COMBINING ARCHEOLOGY WITH MODERN GAME DESIGN TO CONVEY SWISS CULTURAL SITES

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ABSTRACT

The intention of the project is to get a target group of younger, technology-savvy people engaged in the cultural heritage sites in the canton of Basel-Land.

This article deals with the synergy project of the Swiss cantonal department for archeology and a young company for modern game design. "The Thief of Homburg" is based on a scientifically accurate reconstruction of the Homburg ruins of 1775. The digital reconstruction not only offers the gaming experience of a standardized "walking simulator" to explore the castle in all its diversity, but also implements stealth and exploration mechanics based on real events.

KEYWORDS

Serious games; game design; archaeology, cultural mediation, historical site, promotion, education, tourism.





CONTEXT

The canton of Basel-Land is rich in castles and palaces from the Middle Ages. The cultural heritage sites are very popular excursion destinations and extracurricular learning places. Basel-Land Archeology and Basel-Land Tourism invest a great deal in the preservation and investigation of these sites as well as in communicating the research to a broader public. For a sustainable development of culture and society, it is of central importance to encourage younger generations to explore their own history and cultural identity.

According to the latest federal statistics, visiting historical and archaeological sites is the most popular cultural leisure activity among Swiss people. Studies emphasize the importance of engaging in one's own culture at a young age. "The Thief of Homburg" makes regional culture accessible in a playful way, while also overcoming the hurdle that children usually get to explore archaeological sites only when accompanied by adults.

TARGETED ISSUE

The computer game prototype presented here is based on real circumstances: it is an attempt to get younger generations interested in the actual historical context of medieval-themed computer games. In the game players familiarize themselves with the upscale living and material culture of the ruling upper class in the late Ancien Régime, and they are encouraged to visit the castle ruins that are still preserved in the area today. So, they learn how to form their own imagination of times gone by, based on historical facts and existing preserved cultural monuments.

PROPOSED SOLUTION

To give players an exciting immersion in the world of Homburg castle in 1775, the game was designed as a first-person role play. Based on true events, the player slips into the role of a thief who tries to break into the castle's residential tower on a Sunday morning, while the bailiff's family is attending mass in the local village. As the game progresses, the player faces the challenges of dodging the guards and servants and locating certain objects in the castle. To solve these quests, it is essential for the player to understand the layout of the various rooms and interact with various items, using them to the player's advantage. This gives a good understanding of the 1775 Homburg castle structure as well as of the daily use objects at that time. Players who are inspired to visit the real ruins of Homburg will be able to correctly assign the complex and the preserved structural castle details based on what they learned while playing the game.

[The Thief of Homburg] is an attempt to get younger generations interested in the actual historical context of medieval-themed computer games.



RELEVANT INNOVATION

Between 2008 and 2010, as part of a comprehensive renovation, the Homburg ruins were precisely documented in terms of their historical components. That research detailed findings form the basis for a detailed digital reconstruction of the 1775 Homburg castle, which makes it possible to re-enter the living environment of a culture that radically changed in the wake of the French Revolution. The life situation of the authorities, but also that of the maids and servants is experienced in the context of a medieval aristocratic castle that was converted into a bailiff's residence. The game's storyline is also based on a real event that has been adapted into a playful, age-appropriate experience.

PROJECT OUTCOMES & RESULTS

The game is currently in the state of an "Early Prototype". Previous game tests have shown that players develop a good understanding of the Homburg castle structure over the course of the game. However, the game has not yet been tested on a larger scale. The actual learning factor will be evaluated by a larger game tester group as the next step after completing the prototype. For further development the archeology Basel-Land and Diditopia Games GmbH aim to raise the necessary funds to complete the project.



CONCLUSION

The presented concept shows a promising way to make the attractiveness and the diversity of cultural heritage sites in the Basel area more accessible to younger generations. This playful engagement with historical sites is further linked to a general increase in interest and understanding of one's own cultural history and identity, and the incentive to visit the original sites as part of an excursion.

PERSPECTIVES & NEEDS

The game is currently “Early Prototype”. Previous game tests have shown that players develop a good understanding of the Homburg castle structure over the course of the game. However, the game has not yet been tested on a larger scale. The actual learning factor will be evaluated by a larger game tester group as the next step after completing the prototype. For further development the archeology Basel-Land and Diditopia Games GmbH aim to raise the necessary funds to complete the project.

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EXPANDED PLAY

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KEYWORDS

Playable; hybrid; pedagogy; interactivity; narration; prototyping.

ABSTRACT

For the past twelve years, the Master Media Design programme at HEAD – Genève has been creating games in various forms and formats: games that address social issues, game controllers that rethink the way we interact with stories, and retro-gaming platforms that we transform into pocket theaters for micro-narratives. This short article aims at presenting the methodology that the team of professors in Master Media Design at HEAD – Genève has developed over the years when it comes to teaching the notion of expanded gameplay. To illustrate our approach, we will use the examples of three projects created in the Master's programme.

CONTEXT

The video game industry is today, by far, the primary cultural sector in terms of economic activity. It represents more than twice the earnings of music and cinema combined. In 2022, it is estimated that nearly 3 billion people will play video games, a number that could rise to 4.5 billion in 2030 due to the expansion of mobile games. Video games now constitute an unavoidable cultural and socio-economic paradigm, which is not limited to leisure or a particular age group, and which not only redefines the traditional fields of creation, but also professional circles in a broader, or research and criticism. Furthermore, what we call "video games" today covers a vast and protean area. Some game formats such as puzzles or adventure games are more easily recognizable, but even these are not limited to simple commercial distribution: a game can be deployed in a museum and be fully part of its exhibitions. It can be used in a classroom or during training. A game can also explore socio-historical contexts or spark political controversy. Finally, with the current arrival of real-time game engines on film sets, the boundary between games and cinema is becoming increasingly blurred. For more than ten years, the Media Design Master has offered professional training focused on human-computer interactions, game design, interactive storytelling and the creation of interfaces and connected objects. This is this context where the Master Media Design at HEAD – Genève has been creating games

TARGETED ISSUE

Following Gene Youngblood's notion of "expanded cinema", we offer "expanded play" where the limits of what is meant by play can be explored. What are the possible forms of games that could be invented from this notion of expanded play? What types of new subjects could we address in games? Could this notion help us imagine new tools to create games? More importantly, we try to show how this notion allowed us to create a new methodology of game creation in a school of art and design in Switzerland.

PROPOSED SOLUTION

Our fundamentally hybrid methodology is one of the singular aspects of the Media Design approach on designing games. As our goal has never been solely focused on the game industry, our approach on designing games often includes methodologies emerging from multiple fields within design. An interaction designer, for example, thinks about how you hold the screen, the objects and gestures you use to interact with it, and how designed contexts can augment the experience of gameplay. This gives us the freedom to rethink many

of the common assumptions made about the definitions of what “is” a game, and gives us more latitude to explore where and how a game is played.

Rethinking the relationship of objects, gestures, bodies, games, and screens opens up the physical space of gameplay. Suddenly, all sorts of objects can be transformed into game controllers: books, playing cards, household objects, your face, even the fire from a match can be used to control a game.

From this expanded definition of what a game can be, we investigate the narrative possibilities of gameplay. This includes expanding who is represented in games and what sort of subjects we play on — including controversial subjects such as trauma, sexuality, and war. This also means experimenting with new narrative structures, formats, and technologies — for example artificial intelligence text generators — in order to better understand how they modify the possibilities of play.

RELEVANT INNOVATION

In *Play Anything* (2016), Ian Bogost suggests that the world is an open playground, and that boredom itself can be a source of fun when given the right set of constraints. In our programme, we take a more concrete approach on this idea and apply it not only to specific objects and media, but we even apply it to our own methodology. One of these methodological innovations concerns our use of playful tools that we employ during the creation process itself.

Following the traditions of art movements such as Fluxus, Oulipo, or Brian Eno, we have fine-tuned the use of playing cards as a means of rapidly prototyping project concepts, stories, and forms. These playing cards are not entirely about luck: rolling dice into the void, not knowing what action or question you are seeking quickly becomes a meaningless exercise. Our cards, however, are a designed experience, with specific questions that we want to explore through a collection of constraints that we curate in advance. From this set of possibilities, we introduce games of chance and even competition, to open up new possibilities in the creative process.

Cardboard prototypes are another important tool we increasingly use that allow us to build our project in a playful, emergent context, without getting bogged down by the weight of programming, electronics, or product design — all processes that take time to fine-tune into their essentials.

PROJECT OUTCOMES & RESULTS

In our original brief for the project “A Midwinter Day’s Nightmare”, we asked our students to take a work of classical literature and to re-imagine it as a playable experience involving physical objects. The hybrid solution proposed in this project involved using physical playing cards and the horizontally placed electronic tablet’s camera trained to recognize the unique shapes of the characters printed on each card. While this proposal uses sophisticated technology, the gameplay experience was designed as a specifically analog experience, hovering somewhere in between competitive tabletop cardplay and theatrical storytelling.

In our project *Interactive Narrations*, the hybrid nature of our game design process was not about the medium, but about our collaborators: UNAIDS, Hivos East Africa, the Kenyan Network of Adolescents and Youth of Africa (NAYA) and #GenEndIt. For this project, we asked our students to co-design playable narrations to foster the exchange of information on HIV prevention and treatment among the most vulnerable young women affected by HIV in Kenya. Throughout the semester, this workshop addressed questions around narration in the mobile age, exploring various format types and story shapes. We also explored questions around techno-feminisms and how to conduct ethnographic research online. The result of this collaboration is a series of interactive narrations made with a variety of tools ranging from p5.js, Unity, to Twine and Fungus.

CONCLUSION

The notion of Expanded Play will keep influencing the games and playful experiences that are produced and created in the Master’s Media Design program at HEAD – Genève. Through this lens, we will also explore the new intersection that is appearing between the fields of cinema, games and interaction design.

PERSPECTIVES & NEEDS

Moving forward, we will need to create more crossovers between various departments (cinema, product design...) and various institutions from the cultural and private sectors.

ACKNOWLEDGEMENTS

- › Jean-Pierre Greff, Director HEAD – Genève
- › Daniel Sciboz, former head of Master Media Design program
- › Alexia Mathieu, head of Master Media Design program
- › All the teaching team: Nicolas Nova, Dominic Robson, Pierre Rossel.
- › Our students and alumni

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X-ODE: URBAN RENDEZVOUS THROUGH MIXED REALITY

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KEYWORDS

AR XR MR

ABSTRACT

The objective of the x-ode project is to allow the rendezvous of real or virtual actors i.e., virtual avatars of living beings, connected objects, robots... evolving in identical or different space-time spaces. This concept of rendezvous is essentially a system of connection and real-time request between spatial information acquired in real time: the present, already stored and memorized; the past and the déjà vu or produced by anticipation; the future and the dream.

CONTEXT

The x-ode project strives to stimulate a constructive approach to urban life while using technology as a reflective tool, enabling users to better understand the causal and maybe acausal nature of the physical world that surrounds them. The x-ode project is a platform where living humans, historical figures, fictional characters, dreamed up archetypes and robots share a common space, where connecting through the physical world is the only way for users to communicate between themselves.

TARGETED ISSUE

The type of technology is developed and deployed in the context of multidimensional or hyperspace mixed reality. In this context, the mathematical and algorithmic limits of classical XR must be overcome and thus the underlying computer infrastructures rethought accordingly. The proposed system and device allow to exchange and mix information in real time in distributed space-time databases. The objective is to be able to immerse and make actors cohabit in virtual or physical worlds described from multidimensional coordinates acquired by sensors, any other geo-tracking device operating in 3 dimensions or any system of modeling and representation of virtual worlds. To be able to work in n-dimensions, it is necessary to review and modify the current geometric and mathematical representation of Augmented Reality.

PROPOSED SOLUTION

x-ode brings an important technological correction to the world of mixed reality by creating and using space-time and multidimensional databases where virtual representation of objects and physical environments geometry, i.e., their mathematization, uses truly 3D concepts, as opposed to the classic systems of 3D visual representation mainly inherited from the world of games and virtual reality. x-ode directly addresses the XR correspondence problem between the physical and the virtual worlds by specifically attacking the principal algorithms of visualization and representation of urban models which for the great majority are centered on a more or less realistic visual representation of the cities.

Relevant innovation

-x-ode re-balances the connection between the physical and the virtual worlds by favoring the immersion of the virtual in the physical world rather than the visual or haptic immersion in the virtual world. This approach is based on an analysis of the various difficulties encountered in the massive adoption of immersion headsets or glasses but also on the demonstrated popularity of smartphones in augmented reality. On the other hand, the means of urban signage are constantly progressing and allow us to connect to physical or virtual information in real time without going through immersive mechanisms that necessarily exclude physical reality.

PROJECT OUTCOMES & RESULTS

To this end, we developed a Unity based mobile application prototype which we will release during the 2022 orientation week and ensuing semester at Concordia University in Montreal, Canada. We expect to gather results in terms of event-based community building through anonymized proximity interaction and messaging in a mixed reality context.

The x-ode beta mobile app will have 3 main views:

LIVE, through which users will scan their environment and surrounding in AR for existing objects (post and user proximity markers) as well as to leave geolocated and time-framed messages in AR.

MAP, through which users will see where messages are scattered around the city.

ORBIT, through which users will see other users to whom they are related through proximity interactions and via messaging.





SESSION F EDUCATION & TRAINING

FRIDAY, JULY 1

15:00-15:45



CHAIR : GUY HALLER



OLGA REINAUER

Chemicastle: helping students to understand the structure-property relationship



SWANN PUIG

LusTra (Ludique in French, sorting Trash in English)



YASSIN REKIK

Professional Training via Gamified Augmented Reality Application



22 | CHEMICASTLE: HELPING STUDENTS TO UNDERSTAND THE STRUCTURE-PROPERTY RELATIONSHIP

Olga Reinauer

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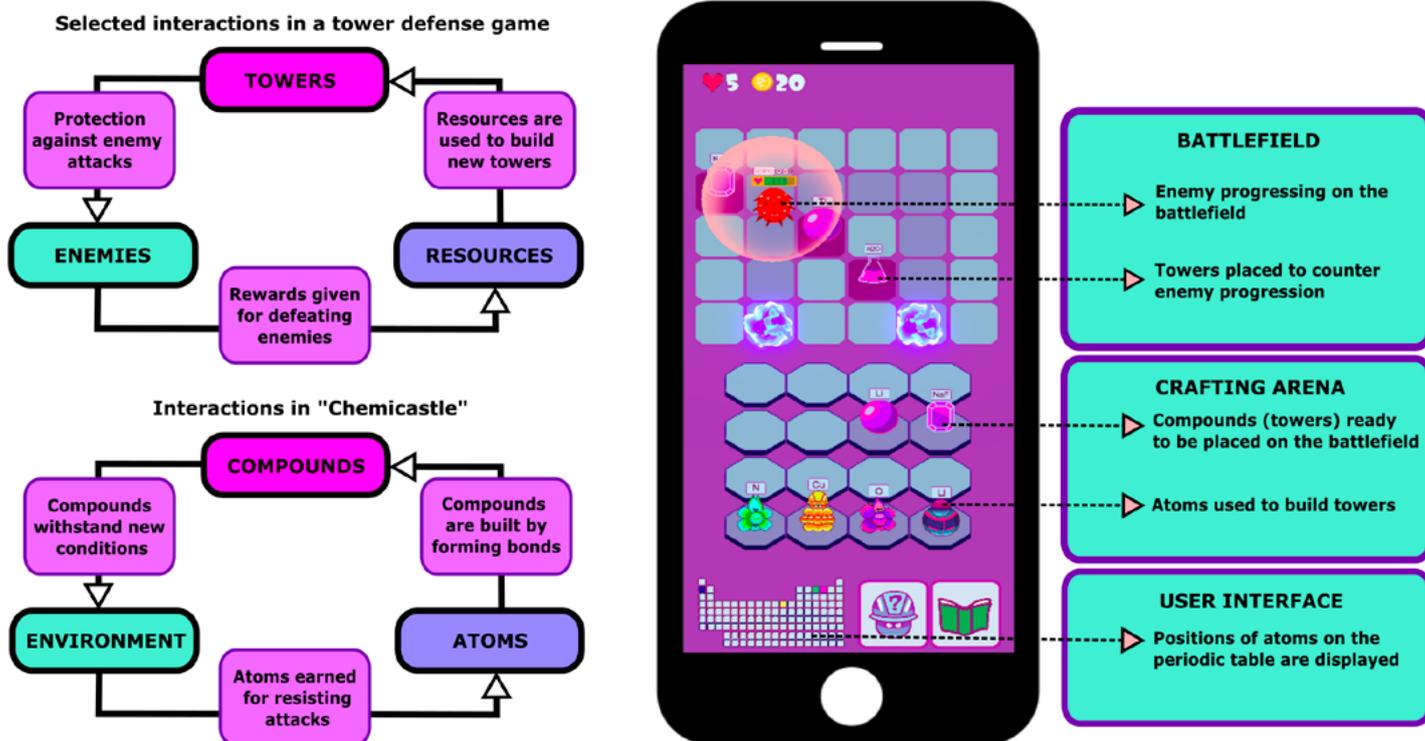
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ABSTRACT

Chemistry is considered by students as a difficult subject to learn. This article presents “Chemicastle”, a mobile game developed with the aim to improve the understanding of the central idea of chemistry: the relationship between the macroscopic properties of substances and their molecular structures.

KEYWORDS

Games for chemistry education; General chemistry; Strategy games;





CONTEXT

Chemistry education programs in Switzerland have one of the highest dropout rates when compared to other study areas [1]. One of the complexities, specific to chemistry, is establishing the relationship between the physico-chemical characteristics of substances and their molecular structures, which requires significant effort from novices [2]. To help students understand this link, researchers suggest interconnecting the core concepts of chemistry such as structures, properties, and energy throughout the course [3,4]. For example, in the curriculum developed by Cooper and Klymkowsky [4], atomic properties are connected to intramolecular bonds and energy changes, which, in turn, are linked to strengths of intermolecular forces and, finally, to macroscopic properties such as melting points or solubilities. It was demonstrated that students taught with this approach were better at predicting the physico-chemical characteristics of compounds from their structures [5].

Games are increasingly used in chemistry education to create an enjoyable learning experience. However, there is limited evidence that they improve the understanding of the structure-properties connection, as the majority of games developed for chemistry teaching are focused on training a specific skill (nomenclature, functional groups, titration, etc.) rather than connecting the core concepts [3,6].

TARGETED ISSUE

“Chemicastle” is a mobile game developed for students enrolled in an introductory general chemistry course intending to improve their understanding of the structure-properties relationship. It interconnects atoms, molecules, energies of intra- and intermolecular bonds, and physico-chemical characteristics of substances in an engaging strategy gameplay.

The game is intended to be used as a complement to traditional lectures, as it does not include quantitative methods such as balancing equations or calculating concentrations. However, it is expected to show why these calculations are important and in what context they are applied.

PROPOSED SOLUTION

The game uses a tower defense mechanic to link molecular structures to a range of properties of compounds: mechanical, thermal, electrical, and solubility. In a typical tower defense game, towers with unique passive or active characteristics are built from available resources and placed on the map to counter enemy attacks. By analogy, chemical substances with distinct properties are represented as towers in “Chemicastle”. They are created from atoms in the “crafting arena” by building the correct intra- and intermolecular interactions and placed on the battlefield to withstand “attacks” of the changing physico-chemical settings (temperature, solvents, etc.).

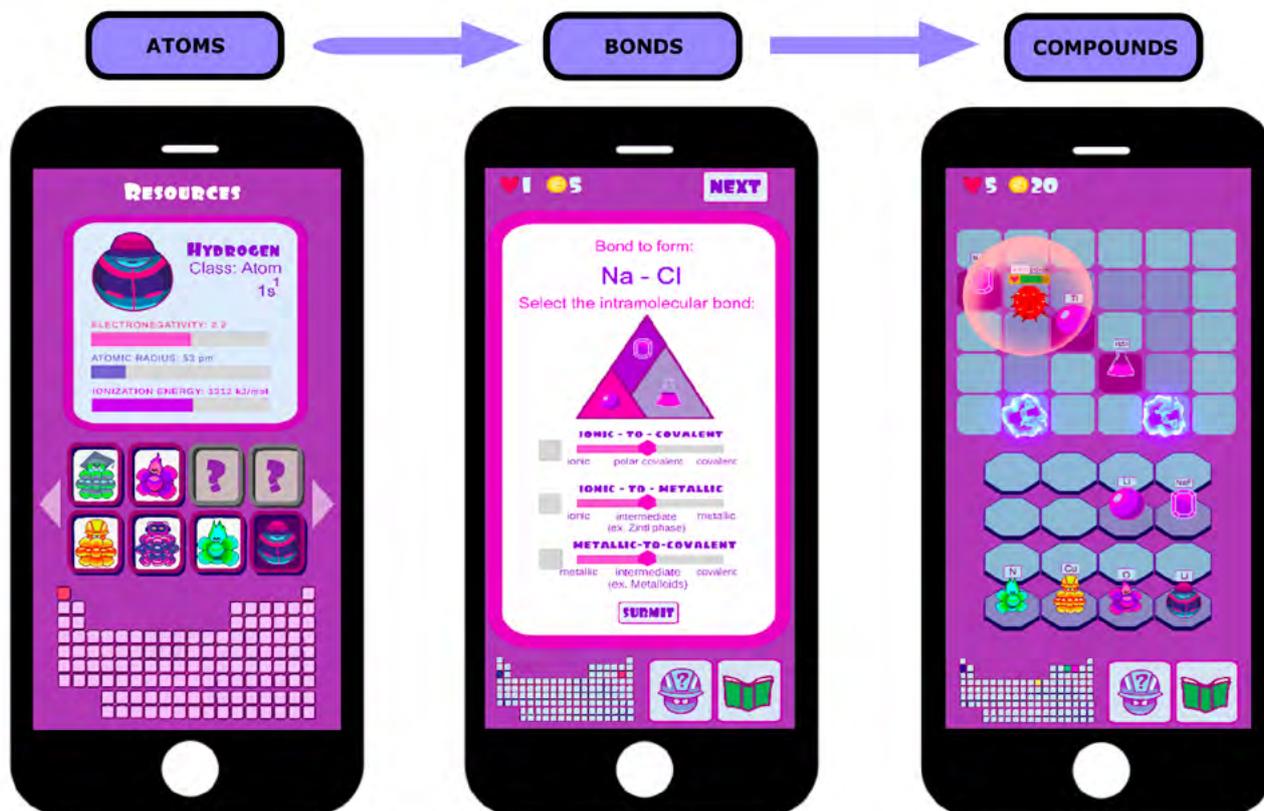
An example illustrates a typical gameplay: an enemy starts moving on the battlefield - an heatwave with a temperature of six hundred degrees. The player has to evaluate if compounds on the battlefield have their melting points below this value and replace them with the ones that tolerate this temperature, otherwise, towers are destroyed. If no such substances are present, the player has to create them from atoms in the crafting arena by appropriately choosing the required types of bonds. When a tower is destroyed by the enemy, an explanation of the occurred phenomena and changes in energy are displayed. The learned concepts include the influence of the periodic atomic properties on the formed bond types, and how different types of bonds affect the macroscopic properties.

RELEVANT INNOVATION

A tower defense game mechanic is customized in this project to help students interconnect the core concepts of chemistry. Throughout the game, the player has to choose continuously compounds with precise properties depending on the battlefield enemy, and simultaneously evaluate what substances can be built

“Chemicastle” is a mobile game [interconnecting] atoms, molecules, energies of intra- and intermolecular bonds, and physico-chemical characteristics of substances in an engaging strategy gameplay.





from the available atoms. By repeatedly coordinating these actions while receiving instantaneous feedback, students are expected to build progressively an expert-like knowledge in chemistry, which, according to Johnstone [2], is characterized by the multi-level thinking: perceiving the phenomena (the “macro” level), explaining them with atomic or molecular interactions (the “sub-micro” level), and representing them with formulas or equations (the “symbolic” level).

In “Chemicastle”, as in other real-time strategy games, players have to process several tasks at the same time: managing resources, interacting with enemies, tracking changes in the environment, and reading messages from the user interface. “Chemicastle” applies several game design techniques to avoid overloading the players’ working memory [7]. For instance, the tasks of combining atoms to form compounds and choosing which towers to place on the map are linked in a logical sequence to avoid attention splitting on multiple actions. Furthermore, different types of atoms (alkali metals, halogens, noble gases, etc.) and bonds (ionic, metallic, covalent) have very distinct visual styles.

PROJECT OUTCOMES & RESULTS

The game is in the final stage of development: more than two hundred compounds can be built from approximately twenty atoms. “Chemicastle” can be played anytime and anywhere on a mobile phone in short, ten-minute sessions, as a complement to traditional lectures. The exact number of sessions required has to be determined by testing the game.

The expected outcome is that students playing the game could better link macroscopic properties of substances to their molecular structures when compared to a control group. This skill could be tested with oral assessments, for example, by comparing thermal, mechanical, or electrical properties of a range of compounds and explaining the differences.

CONCLUSION

This article presents the development of a serious game for chemistry students. It is expected to improve the understanding of the structure-property relationship by interconnecting atoms, molecules, intra-, and intermolecular bonds, and physico-chemical characteristics of substances. A tower defense game mechanic is adapted to link the core concepts of chemistry.

PERSPECTIVES & NEEDS

“Chemicastle” is a personal hobby project. The goal of this networking call is to partner with educational institutions to get advice, evaluate the user experience in order to finalize the game, and test the game with students.

ACKNOWLEDGEMENTS

The author would like to thank Mr Sylvain Reinauer for the artwork.

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23 | LUSTRA (LUDIQUÉ SMARTRASH)

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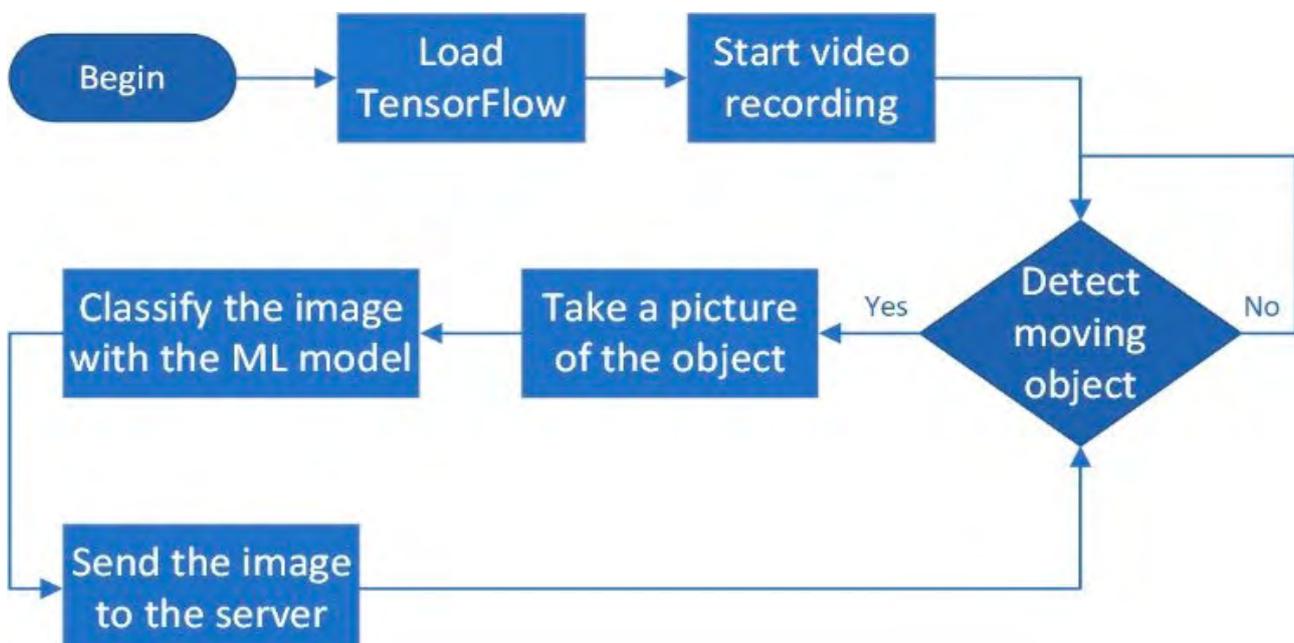
ABSTRACT

“LusTra” comes from “ludique” in French and “sorting Trash” in English. It is a motivating and playful sorting system to educate the young public to the right gestures; thus, recycling becomes a natural reflex thanks to an interactive and rewarding gamification system. We used machine learning methods to train models on the sensor data to recognize the waste types and return the information to the child via a playful interface. This is a real challenge when we know how difficult it is to differentiate Polyethylene Terephthalate (PET) from glass, as well as to detect paper. In this first stage of the work, we mainly focused on PET detection.

KEYWORDS

Gamification; IoT; AI, Machine Learning; Deep Learning; Image classification; Image recognition; Waste recycling; Waste sorting; Sorting system; PET.

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CONTEXT

For some years now, the amount of combustible waste in Switzerland has not increased. However, the recycling rates of recoverable materials have reached a threshold due to an innovation and optimization lack. The amount of reusable waste can be recycled, thus helping to complete the material cycle, thus preserving resources and the environment. Despite the deployment of differentiated garbage cans, the quantity of not properly sorted waste is a real scourge and can still be reduced at the source. Eco-citizen behavior must be encouraged to banish persistent incivilities. This awareness concerns all the population whatever their social status or age. Therefore, we propose “LusTra”, a motivating and playful sorting system, to educate the young public to the right gestures; thus, recycling becomes a natural reflex thanks to an interactive and rewarding gamification system. Machine learning (ML) methods are used to train models on the sensor data to recognize the different waste types and return the information to the child via a playful interface. This is a real challenge when we know how difficult it is to differentiate PET from glass, as well as to detect paper.

TARGETED ISSUE

Waste recycling is an important part of our goods life cycle. The principle of recycling is to reuse the waste, but waste recycling facilities are facing a huge challenge: the disruptive wastes that are not well sorted and sorting errors represent additional management costs. The most known recyclable plastic type is Polyethylene Terephthalate (PET). Differentiating plastic types is a crucial sorting issue. One way to solve the sorting errors is going to the source of waste: people. By educating people as young as possible we can achieve fewer errors. Providing feedback to the recycling facilities managers can also help to decrease the error rate.

PROPOSED SOLUTION

In the recent years, there are several works on waste detection with deep learning ^{[1][2]}. In the waste and recycling industry, only a few companies ^[3] already use their own deep learning algorithms to sort materials more accurately and efficiently. None of them combines the gaming aspect with ML recognition to give feedback to the young children ^[4]. In fine, “LusTra” aims to develop an intelligent trash for educational purposes ^[5].

LusTrash deals with a recycle bin enhanced with a waste recognition system that educates children to properly recycle their waste ^[4]. It also provides statistics on the sorting quality in recycling bins thanks to an embedded system (Raspberry Pi and sensors). These statistics are provided to the facilities manager to improve the waste collection strategy. ML methods are used to train models [Bin18] ^[6] on the sensor data to recognize the types of waste and return the information to the child via a playful interface. We explore the performance of Convolutional Neural Networks (CNNs) inside the waste recognition system. In machine learning, CNNs are mostly specialized in image recognition. We started the project from scratch. We gathered our own dataset by setting up a trash can which contained an embedded video and lighting system. The camera takes pictures of the garbage being thrown away and a ML model classifies the images. One of the challenges was to develop the best ML classifier model from the pictures and evaluate its performance. We used and compared seven types of CNN algorithms. Moreover, “LusTra” is the unique system that combines the gamification aspect with the material recognition and predictive ML techniques to give feedback to young children.

LusTra [is] a motivating and playful sorting system, to educate the young public to the right gestures



RELEVANT INNOVATION

LusTra is the unique system that combines the gamification aspect with the material recognition and predictive learning techniques to give feedback to young children. Thus, LusTra aims to develop for educational purposes a mobile smart recycling prototype that can be deployed in different cultural events and awareness campaigns. The 4 labelled smart garbage cans integrating sensors and ML algorithms will allow the recognition of discarded materials, and the introduction of a feedback incentive interface (game) to sort garbage. For this purpose, a gaming interface prototype has already been developed. Among all the considered recycling proposals none of them combines the gamification aspect with the material recognition and predictive learning techniques to give incentive feedback to young children.

Moreover, LusTra also provides the manager with remote feedback about the sorting quality in recycling bins.



PROJECT OUTCOMES & RESULTS

Our results show that CNNs have difficulties distinguishing between PET and glass bottles on a classification “PET versus Other (non-PET)”. It suggests that CNNs are strong to classify different shapes but weak when shapes are similar. It led us to try a classification of “Bottles versus Other (non-Bottle)” which performed better than “PET versus Other”.

The gaming interface prototype has been developed as a wheel of fortune that 1) teaches children to correctly sort the different materials and 2) motivates correct behaviors with an incentive rewarding strategy.

CONCLUSION

The solution to use ML image recognition to classify “PET versus Other (non-PET)” recycling categories guarantees a trash can content with an approximate 10% error. A sorting system can use this solution in combination with other existing material identification techniques [7]. Our solution of a distributed Internet of Things (IoT) system takes advantage of a continuous improvement cycle.

PERSPECTIVES & NEEDS

We envision different tasks:

- 1) Applying the ML recognition methods on other materials as we mainly focused on PET.
- 2) For this purpose, we need the prior selection of sensors according to the materials.
- 3) Testing the playful interface in order to improve it as a final user application beyond the prototype.
- 4) Integrating the interface with the waste recognition system.

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24 | PROFESSIONAL TRAINING VIA GAMIFIED AUGMENTED REALITY APPLICATION

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CONTEXT

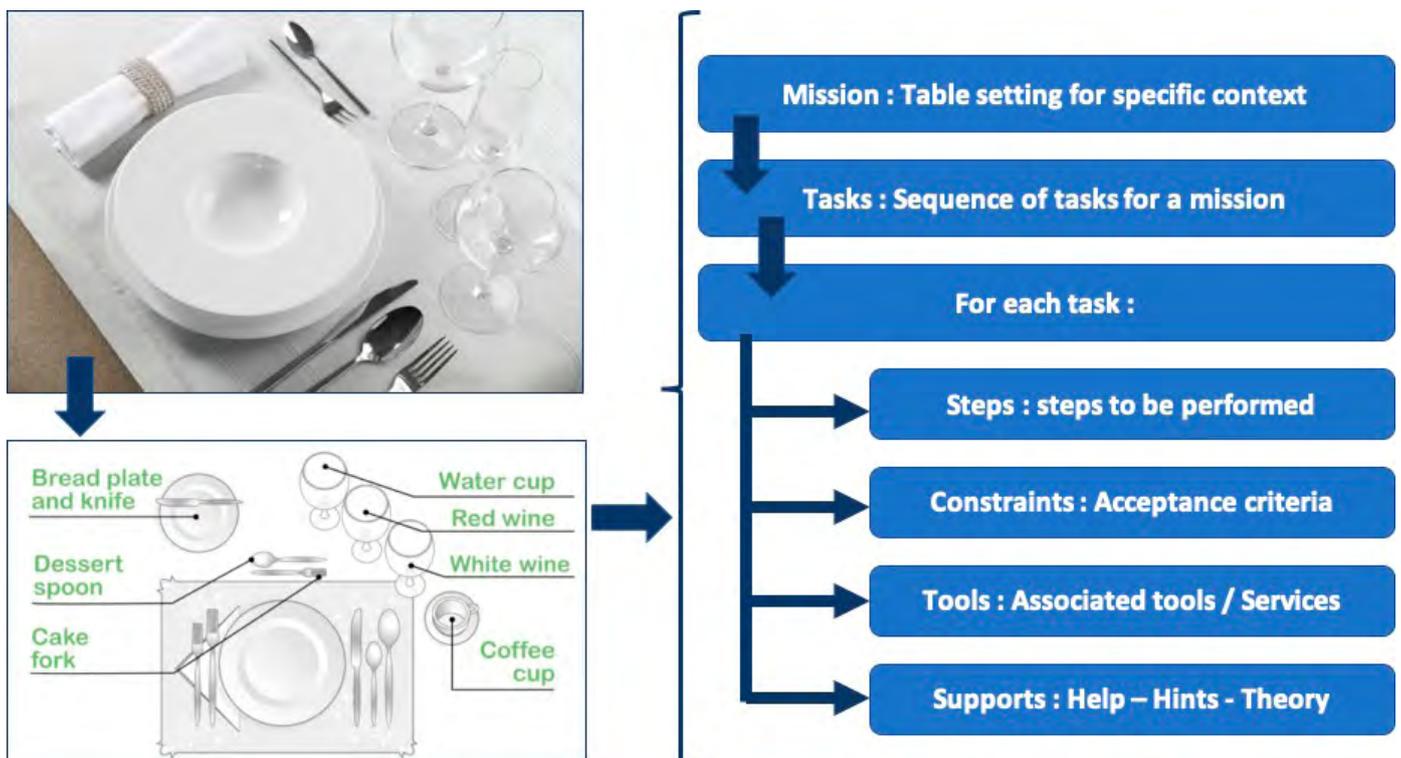
For 70 years, Orif has had the mission of observing, training and promoting socio-professional integration of people with health problems or those in difficulty. It creates and manages appropriate structures and develops any measure promoting socio-professional integration in order to carry out the mission entrusted by the socio-economic partners. To this end, its main tasks are:

- › create and manage structures adapted to the accomplishment of its mission
- › develop any measure promoting socio-professional integration
- › carry out the assignments entrusted by the socio-economic partners
- › participate in social policy
- › collaborate with economic circles

Recently, Orif started a collaboration with the "I3" (Intelligent Interfaces & Interactions) competence group from HEPIA in order to design and develop an innovative professional training solution based on well-established processes. The objective of this collaboration is to develop an augmented reality solution allowing trainees to carry out business processes in mixed reality by manipulating virtual objects and tools within a real environment. The objective is to overcome logistical constraints, infrastructure costs and security problems.

KEYWORDS

Professional Training; Augmented Reality; Gamification; Health





TARGETED ISSUE

As part of their professional training, apprentices are often required to study, understand and reproduce tasks and activities while respecting rigorous processes, which often define the sequencing of the steps and tasks to be accomplished, and also define for each of them the needed tools, the targeted results as well as the related best practices. As examples of professions based on such processes, we can mention cooking or baking with the fulfillment of specific recipes, site surveillance with gestures and rigorous operations to be carried out, and table setting with codes and rules to respect.

The objective of the collaboration between Orif and “I3” is to develop a solution that is generic, innovative and rich. First, the solution must be generic in order to be able to cover various trainings and adapt to various processes. Second, the solution must be innovative by allowing apprentices to practice real scenarios with strong immersion: apprentices must feel like in a real situation and have the feeling of being in normal working conditions. Finally, the solution must involve adequate and comprehensive training tools allowing to cover multiple use cases: time-free practice, time-constrained practice, examination, and so on.

PROPOSED SOLUTION

To achieve the required solution and be able to use it in a given context, we adopted an Agile approach to validate the intermediate choices and compare them to real use cases. Initially, we worked on a generic model enabling the definition of the concept of “process” as well as “step” of a process. This modeling work had to be done in a generic and flexible way so as to ensure the need to generate the final solution. In a second step, we selected a particular training and we instantiated our sorting model to cover it. Finally, we developed and selected the virtual objects, the tools and the mechanisms covering all the stages of the selected training process.

As for the process model, we opted for a representation in the form of an oriented graph with the

steps as nodes and the precedence and dependency constraints as arcs. Thanks to this representation, we are not limited to linear and sequential processes, but cover more complex and more varied situations. Each node in our graph represents a specific step (in the process), which is in turn linked to a set of objects and tools allowing the apprentice to carry it out. Each step is therefore associated with:

- › Theoretical resources allowing revisions and/or theoretical reminders to be done during the training sessions;
- › Virtual interactive tools available during this stage and helping the apprentice to accomplish his task. For example, in the case of a recipe preparation process, unit conversion tools or dosing tools may be required;
- › Virtual objects to be manipulated to accomplish the task. These objects strongly depend on the task and must be coupled with rules and controls, specific to each of them. For example, in the case of a training for table setting, a virtual object can be a plate to be placed by the apprentice. This requires to control what plate is selected, the way in which it is placed on the table and finally its relative position in relation to the other elements of dressing;
- › Review and tracking tools. Indeed, the developed solution must ensure a follow-up and a quantitative evaluation of the apprentice’s actions to be used for debriefing.

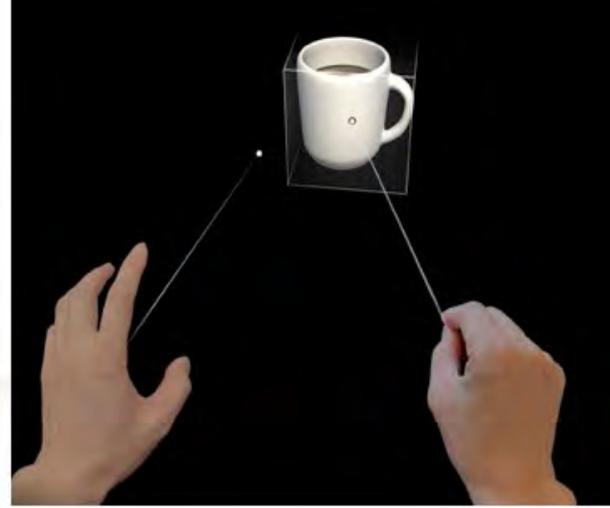
This model has been implemented in a generic way allowing it to be instantiated (applied) in different ways according to the targeted training needs.

RELEVANT INNOVATION

Three major innovations have been introduced in this project. The first one is the genericity of the training tool so that it can be easily and quickly adapted to different training courses, the only constraint being that the training is based on a step-by-step process with a defined sequence and identifiable results. The second innovation is the intensive use of mixed reality to maintain a high level of realism while manipulating virtual objects. This mixed reality allows the apprentice to be in a real work environment and thus feel its constraints and limits. At the same time, mixed reality makes it possible to enrich this real framework with virtual objects

The objective [...] is to develop an augmented reality solution allowing trainees to carry out business processes in mixed reality





Real situation

3D Modeling

Interaction

that the apprentice can manipulate, move and interact with them without being limited by the objects' cost, their availability and the security aspects. The third innovation is gamification. Indeed, with the aim of increasing the acceptability and attractiveness of the training tool, we introduced various gamification aspects to enhance user motivation. Among the gamified aspects introduced we can mention:

- › Scoring: accompanying the apprentice's operations with score and rewards;
- › Missions: training can be performed in the form of missions, which can be carried out in single or group modes, and also in cooperative and/or competitive mode;
- › The time constraint: some training sessions may be limited by time limit to intensify the challenge and put the apprentice in a stressful situation.

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PROJECT OUTCOMES & RESULTS

Currently the project is still in the development phase. The first usable prototype we have targeted is a training tool on the art of table setting [4], which will cover all the stages of table setting: tablecloths, napkins, cutlery, glasses, decor, and so on. It also allows to situate the apprentice in different real scenarios such as buffets, à la carte dinners, and group meals. The tool has three modes:

- › The training mode consists of controlling the actions of the apprentice and guiding him via instructions, notifications and theoretical reminders;
- › The mission mode consists of controlling the apprentice without intervention while keeping logs allowing to debrief his work and note it;
- › The exam mode is similar to the mission mode, but it adds the time constraint.

The tool has been developed with Unity and deployed on Microsoft HoloLens 2 AR glasses. The objective is to be able to carry out tests with real users during next year's fall semester (2022-2023).

CONCLUSION

The development of a gamified professional training tool based on augmented reality has shown the full potential of a mixed reality approach for role-playing and contextualized learning. In addition, introducing gamification in professional processes seems to enhance the user's long-term motivation. This gamified mixed reality approach we adopted to elaborate the first prototype showed the technical feasibility of such a tool, its functional capacity to cover an important part of the training process, and its attractiveness for young apprentices. The first tests are encouraging. We will perform acceptance testing with real users to confirm these positive results.

PERSPECTIVES & NEEDS

The current objective, within the framework of this project, is to find funding to enrich the current prototype on the art of table setting by covering more variants and stages. We are also considering extending our tool to other types of professional training to show its genericity.



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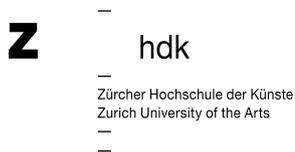


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