Gamebooks and branching narratives in education: fostering sustainability competences to promote positive social change

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Gamebooks and branching narratives are a specific form of interactive literature that allows the reader to participate in the story, making decisions that affect its final outcome. We describe one case-study of introducing branching stories in the context of higher education, and discuss how it possibly enhanced communication and collaboration skills as well as prosocial attitudes. We further generalize this experience to discuss how educators can use branching narratives to promote positive social change. To this aim, we clarify what social development and sustainability competences are, and show how educational activities based on branching narratives can effectively promote their acquisition.

1 Introduction

Today's world is facing global challenges of unprecedented complexity. While the growth in socio-economic inequalities increases poverty and hunger, climate change and environmental degradation threaten ecosystems as well as human wellbeing; at the same time, the lack of access to education and healthcare hinders inclusive and sustainable development (Sachs et al., 2022). Contemporary education has the duty of providing the new generations with the competences necessary to face these challenges, thereby to contribute promoting positive social change (Sharma and Monteiro, 2016). In this context, educating to social change also implies educating to sustainable development and sustainability.

Games can support educational systems in educating learners to positive social change and sustainability. On the one hand, many authors have highlighted that sustainability education involves education to action, and that this is best promoted through active learning paradigms (see, e.g., Lozano et al., 2017; Mindt and Rieckmann, 2017). On the other hand, as many studies have shown, game-based learning (Plass et al., 2015) provides a rich environment that increases engagement and motivation as well as academic success (Ryan and Rigby, 2020). Thus, the use of games in educational contexts seems valuable to educate sustainability.

In this article, we propose that educational activities based on branching narratives and gamebooks—i.e., a specific form of interactive literature that allows the reader to participate in the story, making choices that affect its final outcome (Green, 2014; Arnaudo, 2023)—are particularly suited to support education in promoting positive social change and sustainability. Indeed, several features of gamebooks make them extremely effective as a subject for game-based learning and as a tool to promote social change competences by both helping spread knowledge about sustainable development and sustainability and fostering those skills,

attitudes, values, and competences that are necessary to a sustainable society.

To clarify how school teachers can exploit them in education, section 2 introduces gamebooks and branching narratives, differentiating them from similar concepts such as interactive fictions (Montfort, 2005; Glassner, 2017), and graphic adventures (Reed et al., 2020). Section 3 then describes one case-study of using gamebooks and branching stories to teach game design in the context of higher education, and discusses whether and how it enhanced communication and collaboration skills as well as prosocial attitudes.

In section 4, we further generalize this experience to explore how educators can use branching narratives and gamebooks to promote positive social change. To this aim, we argue that positive social change requires educating to sustainability (Purvis et al., 2019). Under this assumption, we refer to the GreenComp framework (Bianchi et al., 2022) to clarify which sustainability competences education should aim to develop.

Hence, section 5 discusses how educators can introduce gamebooks and branching narratives in an educational setting specifically to promote sustainability competences. The section analyzes the variety of knowledge, technical skills, soft skills, and attitudes that learning activities with gamebooks can help develop. We conclude that a particular method based on asking group of learners to design and write original branching stories—what we call Branching Narrative Design-Based Learning (BN-DBL)—is the most promising for using gamebooks to promote sustainability.

2 Branching narratives and gamebooks

We ultimately intend to argue that gaming activities with gamebooks and branching narratives are an effective example of game-based pedagogy to promote positive social change and sustainability education. We start from clarifying their nature.

2.1 Branching narratives

Branching narrative is a particular kind of ergodic literature, i.e., a fictional narrative that requires a non-trivial effort to be experienced (Aarseth, 1997). The clearer example of ergodic literature are hypertexts, that is, texts constituted by pages or images non-linearly accessible: every portion of the text offers different chances for continuing reading, and the reader selects one of them to proceed.

The archetype of hypertexts is the analog *Encyclopédie* and their literary tradition has been already theorized, among the others, by Borges (1962). In more recent times, they have been implemented in the digital World Wide Web, which is structured around links that allow users to browse sites, as well as in interactive fictions, that is, textual video games (e.g., *Zork*, Anderson, 1977) where the player interacts with a fictional word through textual instructions and commands (Montfort, 2005; Glassner, 2017).

If one does not restrict the notion of narrative to (fictional) literature, even videogames can be considered as examples of ergodic narratives because they allow the player to discover the prosecution of a story only by putting effort to interact with the game. Thus, for instance, in platform video games (e.g., *Super Mario Bros.*, Miyamoto, 1985), the player must usually overcome enemies and obstacles to finish a series of levels along a linear story; or, in video games that focus more on storytelling elements such as graphic adventures (e.g., *The Secret of Monkey Island*, Gilbert, 1990), players are required to solve a sequence of puzzles, riddles, and enigmas to engage with a rich fictional story (see Reed et al., 2020 for an overview on the genre).

Thus, a branching narrative can be considered as a transmedia unit operation (Bogost, 2006), that is, a discrete, interlocking and formal brick of meaning construction that can be expressed in different media, regardless of its content and format (analog or digital). For reasons that will become more evident in the prosecution of the reading, in this article we restrain our focus on a specific form of branching *literature*, i.e., gamebooks.

2.2 Gamebooks

A gamebook is a nonlinear hypertext set in a fictional branching narrative where the player is asked to make choices without the involvement of motor skills (unlike in many real-time video games). The text of a gamebook is broken into sections (e.g., pages, or short paragraphs) indexed with either (page) numbers or links (in analog or digital environments, respectively).

The entire story of a gamebook includes a series of pathways that branch out through crossroads that the author (writer) offers as choices to the player. After reading the first section, the player is required to continue reading only the section that corresponds to their selected path. Reading continues from each section to the next one, following the links that the author has made available in each section.

Thus, in gamebooks, the player makes use of a game system (structured by analog rules and/or digital affordances) to select a specific storyline, which is a unique narrative route realized from the many possibilities offered by the book (and designed by the author). Through making decisions, players direct the thematic content (*fabula,* Propp, 1968) of the narrative they will read, the chronological structure of the events within the narrative (*syuzhet*), and their relation. Moreover, after finishing the reading, players can start the gamebook again; their different decisions will orient the new reading on a different storyline.

The relations between the sections of a gamebook can be represented in a tree graph such as the one below (Figure 1), which also describes a player' reading experience (the pathway emphasized in red). Tree graphs such this describe the dialectic between the tree of possible pathways within the pages of a gamebook created by the designer and the single one performed by the player. They are simple and clear tools to represent and communicate the minimum ontology shared by ludic phenomena and constituted by the relation between the structure (*game*), the agency (*play*), and the medium (*toy*, see Mosca, 2017).

Gamebooks emerged as a particular form of branching narrative in the late 1970s from the convergence of two main cultural movements from the previous decade: the theoretical debate in literature and semiotics studies about the presence of the reader inside the text (Iser, 1978) and her ability to act on the text itself (Calvino, 1973, 1979; Eco, 1979), and the technological diffusion of hypertexts, linked to the pioneering home computing after the birth of desktop applications designed to create digital hypertexts, such as *Hypercard* (Atkinson, 1987), and *Toolbook* (Vv, 1989).
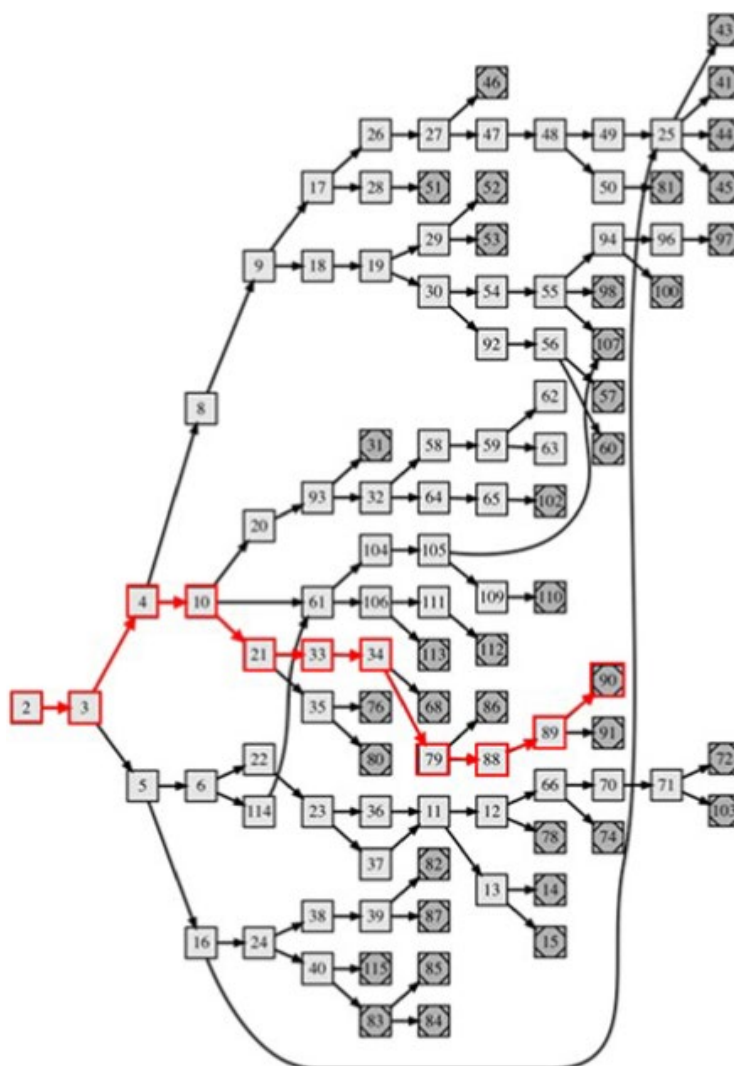
FIGURE 1
The cave of time (Packard, 1979). Graph from Douglass (2017).

The possibility to interact with the text led publishers to inevitably link this kind of literature to playful activities, and therefore to young readers.[1] Therefore, despite some intellectual theorizations, interactive literature arose to commercial success in the early 1980s as pop English literature for kids and young adults, following the direction of *Dungeons & Dragons* (Gygax, 1974) with titles like *Sugarcane Island* (Packard, 1976) and *The Warlock of the Firetop Mountain* (Jackson and Livingstone, 1982).

The success was due to several factors. Many series of gamebooks had attractive editorial coherency reflected in clear and recognizable aesthetics, with paperback format, easy and fast to read, cheap prices, and good distribution in bookstores and newsstands. From the point of view of narrative, publishing companies exploited the fantasy genre,

and referred to cinema and comics—rather than to the literary tradition—to attract younger readers. The gameplay became progressively more interactive, with increasingly more complex rule systems added to the branching mechanism. Finally, the introduction of young adults to narrative experience in the game and challenge form constituted a sort of anthropological rite of passage to make experience of qualities and abilities as anticipation of adulthood.

Gamebooks and branching narratives thus represent a popular form of entertainment. As gaming activities, they are also interesting for applied cases of game-based learning.

3 Gamebooks and branching narratives in higher education: a case study from the University of Turin

To clarify how gamebooks and branching narratives can be used in education, we now report the teaching experience and method that one of us (dr. Ivan Mosca, hereafter referred as "the instructor") has

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1 As it also happened in Italy, where Rodari (1971), famous writer of books for children, adapted an experiment of interactive radio show to tales with three endings.

developed and progressively refined for 9 years (2014–2023) while teaching the elective course named *Game design—Laboratori vari I, canale E, S2411* (from now on, *Game design*) within the undergraduate study program in Communication Sciences at the Department of Humanities (Studium) of the University of Turin, Italy.[2]

The course introduces students to the principles and practice of game design, referring specifically to branching narratives as a type of gaming activity for both learning about and practicing game-design (*Branching Narrative Design-Based Learning*, BN-DBL). Over its duration, students learn to analyze, design, and produce different kinds of branching narratives in both analog and digital medium.

In this section, we present the instructor's considerations in structuring the course followed by the five steps of the ADDIE model for instructional design (see, e.g., Larson and Lockee, 2014) with a specific focus on the analysis and design phases. Because the program has been assembled progressively over several years, we decide to focus here on its last edition (academic year 2022/2023), which represents the most refined version and embodies the instructor's experience and experimentation with all the previous editions.

3.1 Analysis

The "A" of the ADDIE model stands for "Analysis." This phase of instructional design prompts the instructor to define the setting, the target audience, the instructional goals, and the resources of a particular learning activity or program.

3.1.1 Target audience

In the present case, the learning program refers to the elective course *Game Design* at the Department of Humanities of the University of Turin, Italy. The course is provided during one semester, and enrolls by now about 30 undergraduate students, aged 20–24, each year (see Supplementary Appendix: Table C).

While it initially consisted in 4 classes of 3 h each for a total of 12 h, its duration increased in time following success among students and appreciation in the faculty (see Supplementary Appendix: Table A). In its latest edition, the course amounted to 12 classes of 3 h each for a total of 36 h. Students are supposed to spend in individual and group learning the same amount of time they spend in the classroom.

3.1.2 Learning goals

The course's main goal is to have students learn how to analyze, design, and produce games in either analog or digital format using the most renown theoretical frameworks for game design (e.g., the MDA framework, Hunicke et al., 2004).

As it belongs to the undergraduate study program in Communication Sciences, the course also aims to develop cognitive skills (analysis, interpretation, and design thinking), relational skills (communication and cooperation), and an open attitude toward discovering new areas of knowledge and social relations.

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2 During the first 4 years, the course has been proposed as a seminar associated to the main course *Understanding media* (history of media) held by Prof. Peppino Ortoleva. After good reception by the students, the Department made the course independent.

3.1.3 Setting

The setting and resources for the course are traditional for teaching activities at the university. Learning takes place in classrooms furnished with desks large enough for tabletop gaming, and computers with internet connection available to each student. The instructor has access to white boards and a projector device. For chamber LARP sessions, open spaces are also available.

3.1.4 Pre-requisites

Because of its elective nature, enrolled participants are likely interested in gaming although this is not necessary. Accordingly, the instructor does not presuppose prior knowledge of games, game-design, programming and coding abilities on the part of the participants (see section 3.5 for further discussion on the composition of the audience attending the course).

3.2 Design

The first "D" of the ADDIE model stands for "Design." This phase requires to define the learning objective(s), the structure of the program, the instructional strategies, and the tasks that learners are expected to accomplish to reach the instructional goals set in the previous phase.

3.2.1 Learning objective

As to the main learning objective, both theoretical and practical reasons suggested the instructor to focus the course on branching narratives—and, in particular, on (short) gamebooks. On the theoretical side, it is widely acknowledged that gaming involves both narrative and interaction through a series of rules and/or affordances (Juul, 2005; Aarseth, 2007). Accordingly, gamebooks and branching narrative offer a rich example of gaming activities as they focus on developing a narrative while making players interact with a system of mechanics. More in general, gamebooks instance many fundamental features of games, and represent a very minimalistic, and yet effective exemplar for the whole category. This makes them a valid object of attention and case study for teaching game design.

On the practical side, gamebooks have also many advantages for the didactics because—due to their simple algorithmic logic—they encourage the practice of game design without imposing the heavy technical requirements typical of videogames and other kinds of branching narratives. For instance, creating digital interactive fictions requires coding skills, and creating graphic adventures or videogames also necessitates time to draw the graphical elements. This makes the creation of interactive fictions, graphics adventures, and videogames unnecessarily complex for non-IT students in a short course. In contrast, gamebooks and text branching narratives:

- are easy to learn, play and master;
- are easy to be designed and created in an analog medium, without coding;
- are easy to be adapted to a digital medium (e.g., digital hypertexts);
- are quick to playtest.

Accordingly, the instructor defined the learning objective of the course (as a specification of its goal) in having students analyze,

design, and produce the prototype of a (short) gamebook or branching story, in either analog or digital format.

Moreover, the instructor decided not to further specify learning objectives for the secondary goals previously identified (e.g., improvement of communication and cooperation capacities, consolidation of an open attitude toward new knowledge and relations) although he could definitely expect the course to impact on those as well.

3.2.2 Structure of the program

To obtain the defined objective, the instructor designed a program mixing theory learning and practical activities for every lesson (following what suggested by Gagné, 1985; see Supplementary Appendix: Table B for a sketch of the syllabus).

The instructor identified core and secondary knowledge necessary for students to properly understand and structure their game design activities. Secondary knowledge identified monographic topics—such as "the historical LARP"—of particular interest according to the instructor, and which could change every year.

Core knowledge referred to both general and more specific topics. General topics included the nature of gaming, the epigenetic evolution and the ontogenetic development of playing attitudes, the history and ontology of games, the cultural value of gaming, the definition of game genres, and the main concepts of game design.

More specific topics focused on branching narratives as a type of gaming activity—as this would then be the selected gaming activity for both learning about and practicing game-design. Lessons referred to nature of branching narrative and gamebooks, their history and features, as well as the core competences necessary to design and realize them.

3.2.3 Instructional strategies

As to content learning, the instructor chose a deductive method. This is aligned with the introductory nature of the course, where students need a clear foundation from which to begin with a new language. Through lecturing, the first part of each lesson would familiarize learners with general topics on gaming and game design, followed by specific examples and more specific activities to support knowledge retention.

The content presentation in the first part of each lesson constitutes the basis for students to actively play games (Prince, 2004), and practice specific game design patterns in the second part of the lesson. At this moment, students work in groups, playing and experimenting with theoretical tools, case studies, and practical exercitations to acquire technical skills related to game (and gamebook) design and development. Thus, actively creating a gamebook or a branching narrative becomes the leading activity to reflect on and learn—a learning method that we hereafter call *Branching Narrative Design-Based Learning* (BN-DBL). In the present case, BN-DBL was exploited to teach how to create games, in general.

The choice to adopt a BN-DBL approach depended on the fundamental assumptions that game design should be primarily focused on a player-centric approach revolving around experience and awareness. Game-based learning is a renowned and effective didactics that focuses on the activation of the player/learner. The activation puts the player at the center of the representations that constitute the game: this increases the awareness of the learner about the topics, the goal, and the methods of learning.

Awareness is widely considered as one of the fundamental properties of the gaming ontology as it is impossible to play without

knowing of playing (Caillois, 1958). Designing games could be defined as a particular way of playing games, a sort of meta-game that let develop a meta-awareness. Thus, by requiring students to create the game they will play, choosing the BN-DBL approach enhanced the potentiality of game-based learning.

In particular, game design-based learning is very effective with gamebooks, because gamebooks include the algorithmic logic of the gaming properties, representing them in clear and simple practices. The students who follow a BN-BDL class learn to design games by following the player-centric design format (DeKoven, 1978), which includes theoretical tools and the making of practical experiences.

The player-centric game design format has been merged with the aforementioned three-level ontology that distinguishes a *play* activity, a *game* structure, and a *toy* medium. Gamebooks provide a compendium of this ontology: making choices, the player selects a particular storyline (play/performance) from the many offered by the tree of possibilities (game/system) displayed by the pages (toy/object). The appropriation of such properties is very useful for the development of an algorithmic logic that can be extended to design different kinds of games.

The easier way to design games (in this case, gamebooks) is to start by designing the play activity, focusing on the feelings that the designer wants the player will experience. To implement the player agency into a gaming structure, it is then necessary to take into account rules and mechanics, and finally to create the material medium through which the players will face the game. On the contrary, the players will first face the toy level, then the rules of the game, and finally experience the game as intended by the designer (Figure 2).

In order to do so, BN-BDL students follow the MDA framework (Hunicke et al., 2004) that defines *mechanics* as the descriptions of the fundamental functions of a game, *dynamics* as the behavior of the players that emerge from the mechanics (e.g., strategies), and *aesthetics* as the ways throughout which mechanics and dynamics are experienced by the player.

Students learn how to apply the MDA framework to gamebooks: mechanics affects medium, interface, interaction (objects and obstacles), and system, also exploring the relation between the gameworld ontology (Zagal et al., 2005) and the player epistemology (*FF*-like and *CYOA*-like); dynamics affect narrative (goal-oriented or open story) and storyline (true path or multipath); aesthetics affect representation,

FIGURE 2
The inverted sequences of designing games and of experiencing games.
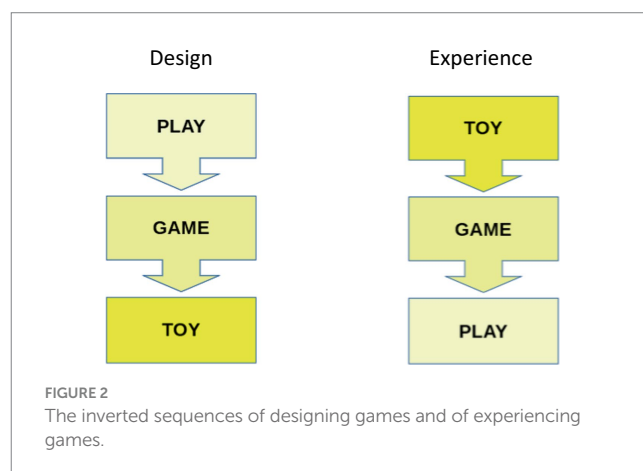
cheating, and setting. Supplementary Appendix: Tables F1–F6 provide in-depth analysis of the MDA framework applied to gamebooks.

3.2.4 Tasks and assessments

In alignment with the course's main goal and objective, the instructor decided that completing the course would require students to successfully accomplish the following tasks:

1. Follow and interact with the frontal lessons focused on theoretical framework;
2. Play some games through different media (e.g., a roleplaying game implemented as a tabletop game, in in a digital environment, and in a living-action roleplay);
3. Play samples of, and become familiar with at least five kinds of branching narrative (e.g., an analog *CYOA*-like gamebook without rule system, an analog *Fighting Fantasy*-like gamebook with rule system, a digital *CYOA*-like with hyperlinks, a digital *CYOA*-like with hidden pages, and an interactive fiction with parser);
4. Create 2 analog gamebooks (a *CYOA*-like gamebook without rule system, and a *Fighting Fantasy*-like gamebook with rule system);
5. Create 3 digital versions of those gamebooks by programming in HARROW and/or HTML languages (this game should include variables, conditionals, media contents like images, videos, and sounds), carry out the testing of the prototype, and publish online the final version.[3]

As the course was elective, the instructor planned for no final grading to encourage an approach focused on autotelic activities, where students play and pay attention to what they do—without being distracted by external rewards. This is very close to what Suits (1967) defines a "lusory attitude," i.e., a wit tied to the voluntary attempt to overcome freely adopted obstacles.

3.3 Development and implementation

The second "D" and the "I" of the ADDIE model stand for "Development" and "Implementation," respectively. We discuss these two steps only briefly as they share less the focus of this article on the design of learning activities with branching narratives.

In the development phase, the instructor updated each year his knowledge of the state of art about the course subject checking the latest game studies and game design publications. Then, he prepared all the course materials (slides and other sources for content presentation for each lesson, design of practical activities and tools for assessment) coherently with what planned in the design phase.

In addition to this (more or less) recurrent material, the course focused every year on a different monographic topic, which also involved organizing a related list of guest speakers from the area of game design studies and the game industry, and planning for different dissemination of the course activities.[4]

In the implementation phase, the instructor received the roster of the students enrolled in the course, started the communication with them before the beginning of the lessons, delivered an initial survey to assess their needs and expectations (see Supplementary Appendix: Table C), and the finally delivered the teaching.

3.4 Evaluation

The final "E" of the ADDIE model stands for "Evaluation," which includes both formative and summative assessment. The first refers to (self-)evaluation performed during learning activity to make learners aware of where they are currently situated in the learning path, the second to the evaluation carried on by the instructor at the end of the course to assess students' final acquisitions.

To promote formative assessments during the course, students were asked to deliver the results of some in-class and homework tasks: (i) the analysis of a particular game, (ii) the modification of an existing game, (iii) the mixing of two games, and finally (iv) the realization of an original game (analog and digital). The instructor evaluated the development of individual learning, commented on the accomplished tasks, and provided suggestions for further learning. Many students also spontaneously asked for advice to give fruitful direction to their project.

By the end of the course, the instructor evaluated the final prototype created by each group of students, checking the functionality of the product (clear mechanics, correct coding, etc.), auditing the playability of the game, and verifying that the design reached its intended goals.

As decided in the design phase, the course imposed no final grade but only a final decision on students passing/not passing the course based on their performance in the 5 tasks (for the results, see Supplementary Appendix: Table D). Moreover, the instructor also evaluated student subjective reaction to the program (Supplementary Appendix: Table E).

3.5 Results and discussion

We now report and comment on data about the course *Game Design* that were collected over the years (see Supplementary Appendix). Because the teaching had not been intended from the beginning for a

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3 Students realized PnP (print and play) versions of analogue games and gamebooks as. pdf documents, which supports circulation on the web. Digital prototypes were published on either open-access platforms such as itch.io, or the social media—this is possible because programs such as *Twine* allow creating digital gamebooks as HTML files. A non-comprehensive repository of prototypes created in the course can be found at https://ivanmosca.wordpress.com/work-in-progress-please-give-a-look-at/.

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4 For instance, the topic for the year 2018/19 was tabletop design, and the instructor invited professional game designers (Andrea Chiarvesio, Walter Obert, Umberto Pignatelli, Francesco Rugerfred Sedda, Pierluca Zizzi), illustrators (Francesco Mattioli), and editors (Lughi, 2015). The prototypes of the games created during the course were presented at the gamecon *GiocaTorino*. The topic of year 2022/2023 was roleplay gaming. Students carried out a session of an educational LARP about a national history event that the instructor developed in collaboration with the LARP designers (for *Terre Spezzate*) Chiara Tirabasso and Francesco Pregliasco, who were also invited for giving a lecture.

research report, the evidence gathered cannot provide an exhaustive discussion. Nevertheless, we hope it will provide further understanding on the experience reported above.

3.5.1 Structure of the course

Over the years 2014–2023, the number of students enrolled in the course, the number of lessons, and the amount of time granted to deliver it have progressed from 12 students, 4 lessons, and 12 h to 30 students, 12 lessons, and 36 h (Supplementary Appendix: Table A). Thus, the course has progressively enriched and provided a wider learning experience to its audience.

3.5.2 Learner profile

Over the years 2021–2023, informal surveys have been submitted to the participants at the start of each course (see Supplementary Appendix: Table C). Compared to Italian averages (IIDEA, 2023), the classes presented more gender equality among players (49% vs. 42% of the Italian average) probably due to the instruction level, and the family games genre is underrepresented (1% vs. 15%), probably because most students are interested in games, who aren't casual gamers interested in family games (Juul, 2010).[5]

Before following the classes, a large majority of students (83%) defined games as a form of entertainment, and many of them did not add other properties. Games are surely entertainment, but following the classes the students learn that they can also be—among the others—educational, social, or artistic tools.

Similarly, the majority of students who followed the classes (68%) expected to increase some knowledge, a large group of them (55%) expected to develop skills and only few of them (7.5%) expected to learn attitudes: this is didactically normal, because knowledge and skills are easier to identify than attitudes and above all because the national scholastic system focuses mainly on knowledge. However, expecting to learn new attitudes is not necessary to do it; hence, data from students expectations say little about what they effectively learnt through the course.

3.5.3 Outcomes

The percentage of students passing the course progressively increased in time, up to 84% of the 2022–2023 edition (Supplementary Appendix: Table D). The data collected from the evaluation of student subjective perception of the course also show good results (Supplementary Appendix: Table E).

In addition, the instructor's subjective perception is also consistent with the gathered data. Normally, the realization of the prototype is very well received by the students, who express pleasure in making use of the theoretical knowledge within the context of a practical attitude. Very often, they widely exceed the required homework effort, and dedicating a large amount of time for developing their games.

It remains to be discussed whether this experience shows that the *Branching Narrative Design-Based Learning* (BN-DBL) approach fosters the acquisition of prosocial behavior, and can thus contribute promoting positive social change. To this, we must reply first that this

goal largely extends beyond the objectives of the course, hence was not opportunely tracked—in fact, the instructor did not define secondary learning objectives to track the acquisition of relational skills and cognitive and social attitudes (see section 3.2). However, this defines an interesting target for future teaching and didact experimentation, which may be expanded to directly answer these important questions.

Second, despite the lack of objective evidence, the instructor had a strong feeling that the playful atmosphere during the course, and the student engagement in group work contributed to improve relational skills such as communication and cooperation, and an open attitude toward discovering new areas of knowledge and social relations. Moreover, along the classes, the large majority of students expressed the awareness of the potential use of what they learned in different contexts, normally far away from game design, identifying it not only as knowledge or skills, but also as attitudes.

Thus, although the reported experience from the course does not provide conclusive evidence that game-based activities with gamebooks can effectively contribute promoting positive social change, it nevertheless suggests that these game-based pedagogies foster prosocial behavior. The interesting research question then becomes if we can use these game-based pedagogies can also raise awareness and sensitivity about social topics, enhance social skills, and urge people to action. To explore these considerations, in the next section we take a more theoretical perspective on our leading question.

4 Understanding sustainability education and competences

To address our leading question, we propose the following agenda. If we identify what sets of prosocial behavior and competences support positive social change, then we can explore whether game-based pedagogies employing gamebooks and interactive fictions can foster these competences. Hence, we will be in a better position to assess—at least from a theoretical perspective—whether gamebooks and interactive fictions can also promote positive social change. To this aim, it is important to get cleared about foundational concepts: What is exactly prosocial behavior, and what positive social change should it favor?

4.1 From prosocial behavior to positive social change to sustainability education

Social change refers to the alteration of mechanisms within the social structure, characterized by changes in cultural symbols, rules of behavior, social organizations, or value systems (Kavanagh et al., 2021). The label "positive" stresses that the actions and initiatives aiming to modify the social structure should result in *beneficial* transformations.

Significantly, positive social change not only addresses the results of social problems—which is the objective of social service—, but also involves long-term responses that address their roots. Thus, positive social change not only calls for people to acquire prosocial skills and manifest prosocial behavior but also for community organizing and legislative advocacy, that is, for initiatives that contribute to changing the causes of social problems, and ultimately to promote *social development*.

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5 This is true mainly for video games, whereas family games such as *Risk!* (Lamorisse, 1959), *Cluedo* (Pratt, 1949), *Taboo* (Hersch, 1989), and *Monopoly* (Magie, 1935) are still the most played board games.

As it is clear to today's scholars and policymakers, social development alone cannot solve contemporary social crises because these originate from complex dynamics that interconnect economic activities, societal lifestyles, and environmental challenges (European Environment Agency, 2019). Accordingly, any action aiming to promote social development must integrate solution strategies for social, economic, and environmental factors, thereby consider the wider concept of *sustainable development* (Brundtland, 1987).

Significantly, contemporary discussion on addressing global crises has also concluded by now that aiming at sustainable development is not enough. To understand why this is the case, we need to distinguish sustainable development from *sustainability*. While the former refers to the processes to achieve progress and development in sustainable ways, the latter refers to a long-term goal, such as attaining a more sustainable world (Purvis et al., 2019). In fact, if we are to properly address contemporary global challenges, nothing less than aiming at sustainability will work as sustainable development implies by necessity sustainability (Sterling, 2001; Rieckmann, 2017).

Significantly, since the World Summit for Sustainable Development in Johannesburg in 2002 (United Nations, 2002), education and lifelong learning are considered as an integral component in sustainable development (see Michelsen, 2015). Thus, the more refined, complete, and advanced goal for educational policies should be educating to sustainability. Sustainability broadly prioritizes "the needs of all life forms and of the planet by ensuring that human activity does not exceed planetary boundaries" (Bianchi et al., 2022), and involves efforts to provide a higher quality of life for people and to achieve economic prosperity while protecting the natural systems of the planet.

4.2 Sustainability competences

Can we foster sustainability with gamebook-based pedagogies? Answering the question presupposes that we know what kind of sustainability competences we can promote with these innovative educational practices (Bianchi, 2020). Thus, let us first focus on the nature of sustainability competences themselves.

Many accounts have identified sets of core competences that educational systems must focus on to promote sustainability capacities among the new generations, and the literature proposes a vast array of terms and taxonomies (see, e.g., Mochizuki and Fadeeva, 2010; Cebrián and Junyent, 2015; Cebrián et al., 2019). Luckily enough, many accounts tend to converge on a core set of competences (Brundiers et al., 2020; Redman and Wiek, 2021; see Bianchi, 2020 for a review).

Herein, we focus on GreenComp (Bianchi et al., 2022), a competence framework developed to foster learning on environmental sustainability in the European Union. Our choice relies on a variety of reasons. First, GreenComp represents one of the most recent proposals, and encapsulates at best the conclusions from the most encompassing frameworks. Second, GreenComp proposes precise definitions for the knowledge, skills, and attitudes composing each competence (see Bianchi et al., 2022, Appendix 2, 40–51). Thus, it is a very practical tool, open to immediate application in the design of curricula and learning activities. Third, while most competence frameworks for sustainability education focus on higher education, GreenComp considers the competences of learners at any level. This allows detaching our discussion from the

context of higher education, and providing suggestions that, with proper adjustments, are valid from elementary education, and can extend from formal to non-formal contexts.

Because GreenComp has been created in the context of the European Green Deal, which aims to promote the transition to a green economy, it focuses not only on environmental issues but also on climate change and sustainable economic development. It comprises 12 interrelated sustainability competences, included in 4 distinct competence areas (CAs). We hereby summarize each of these areas, and identify examples of knowledge, skills, and attitudes that will be suitable for the later analysis of how gamebooks can contribute to sustainability education.

4.2.1 CA1: Embodying sustainability values

GreenComp significantly starts with a reflection on values. In detail, the first competence area considers sustainability itself (1.1 Valuing sustainability), equity and justice for current and future generations (1.2. Supporting fairness), and the preservation and restoration of nature (1.3. Promoting nature).

Knowledge in this competence area refers to the main views, the guiding principles, and the fundamental concepts grounding discussion on sustainability, equity and justice, and the environment.

Skills refer to several abilities to discuss and compare different values, to evaluate the application of specific principles and concepts in real world scenarios, or even to apply them.

Finally, attitudes in this area include the availability to adopt more sustainable life habits and decrease material consumption, open-mindedness and a sense of connection to humanity and the future generations, as well as the commitment to protecting nature and restoring it.

4.2.2 CA2: Embracing complexity in sustainability

The second competence area focuses on promoting the understanding of sustainability issues as intrinsically complex and depending on multiple interconnected systems (2.3. Problem framing). Thus, it highlights that the correct comprehension of sustainability issues requires approaching them from multiple perspectives (2.1. Systems thinking) while also acknowledging the role of socio-political ideologies in shaping the narrative about these issues. Because of this, the area also includes the competence to assume a critical stance in debating and assessing information, assumptions, and arguments (2.2. Critical thinking).

Knowledge in this competence area refers to the principles of complex systems theory, with a special focus on the correct framing of (complex) sustainability problems and the understanding of the manyfold consequences of human action. It also includes the comprehension of how ideological worldviews and narratives shape the discussion on sustainability and the identification of solutions.

Skills in this area relate to understanding how multiple environmental, economic, social, and cultural factors concur to shape and define sustainability issues, to framing sustainability challenges considering transdisciplinarity and the interconnection between systems, and to critically assess evidence about sustainability issues.

Finally, attitudes dealing with complexity in sustainability connect to being concerned with the systemic consequences of environmental crises, being focused toward objective and exhaustive systemic analysis, and being curious and open to discuss sustainability issues while trusting scientific and empirically-informed perspectives.

4.2.3 CA3: Envisioning sustainable futures

The third competence area focuses on all competences necessary to visualize a more sustainable future, and take actions to make it real. This area is fundamental and complementary to the second: while the latter prescribes to analyze complex scenarios that are problematic under the profile of sustainability, this area focuses on envisioning solutions to steer toward desired outcomes. Accordingly, it deals with visualizing more sustainable future scenarios and viable strategies to get there (3.1. Future literacy) while being able both to cope with risk and uncertainty (3.2. Adaptability), and to use a combination of logical analysis and creative imagination in linking ideas and methods (3.3. Exploratory thinking).

Knowledge in this area pertains to knowledge of the main concepts and principles concerned with describing the evolutionary path of complex systems taking in consideration uncertainty, risk, probability, on the one hand, and interdisciplinarity and interconnection of multiple factors, on the other.

Related skills have to do with visualizing and assessing alternative futures, identifying the actions to get there while navigating the ambiguity of information and the uncertainty of the outcome, adapting to different approaches and lifestyles, and combining knowledge, resources, and methods from different disciplines.

Finally, attitudes in this competence area include the willingness to adopt a long-term perspective, and to accept ambiguity and uncertainty, being concerned about the impact of one's own action on the future, being rigorous and systematic in thinking about the future, but also prone to experiment, creative in thinking both inside and outside the box, adaptable in making unusual choices and coping with unexpected environmental changes.

4.2.4 CA4: Acting for sustainability

Finally, the fourth competence area focuses on the competences necessary to take action, or request action from those responsible to shape sustainable futures. Accordingly, it involves competences to plan and take action at the individual (4.3. Individual initiative), community (4.2. Collective action), and collective level (4.1. Political agency).

Knowledge in this competence area involves understanding of the principles and practices behind decision-making processes. To navigate the political system, identify political responsibility and accountability for unsustainable behavior, and demand effective policies for sustainability.

Skills refer to the capacity to act for change in collaboration with others, to identify one's own potential for sustainability and to actively contribute to improving prospects for the community and the planet.

Finally, attitudes in this competence area include recognizing that everyday action matters, being ready to question the effectiveness of policies for sustainability, advocating for individual and collective care and engagement, and taking action to try to solve complex sustainability problems.

5 Promoting sustainability competences with gamebooks and branching narratives

Now that we explained what prosocial skills and competences support positive social change and sustainability, we can turn to the issue of whether and how learning activities based on gamebooks and branching narratives can foster these competences' acquisition and development. This will be our contribution to clarifying of how gamebooks and interactive fictions can promote positive social change and sustainability education. The section provides a variety of ideas to inspire educators to use creatively gamebooks and branching narratives in their teaching—and, of course, in teaching *sustainability*.

With this respect, it is worthy pointing out the variety of strategies that educators can follow to promote learning with gamebooks and branching fictions. They can have learners read and play the stories as well as engage the learners in in designing and writing their own adventures (what we identified as Branching Narrative Design-Based Learning, BN-DBL). Moreover, both reading and writing activities can be performed by the teacher together with the classroom, or assigned to the pupils. In addition, learning activities with gamebooks and branching narratives can be designed for individual student and group work, refer to either paper or digital fictions, employ either analog (e.g., dice) or digital (e.g., real-time clock) game mechanics, and use analog or digital (e.g., *Twine*, Klimas, 2009) tools to assist the learners in the creation.

We should keep in mind such a variety of approaches for using gamebooks and branching narratives in education. In fact, it equips educators with a very flexible tool, which can be adapted to the situation and the kind of competences they want to promote.

5.1 Knowledge

On the most straightforward applications, teaching and learning with gamebooks and branching narratives can support the transfer of knowledge on specific subjects. Significantly, this can happen with reading but also writing activities.

On the one hand, educators can easily propose reading activities with gamebooks to help students become familiar with new content. They can do so by either assigning readings to learners individually, or by reading a branching narrative to the whole classroom (after having defined how the group will take collective decisions about how to go ahead in the story). Such activities of public reading effectively immerse students in a captivating world that combines storytelling and interactivity (Desilets, 2015).

Significantly, selected commercial-off-the-shelves (COTS) can familiarize students with a variety of extra-curricular, but also curricular topics. For instance, for younger learners, many gamebooks are available on adventures and historical subjects (e.g., the series *You Choose: Interactive History Adventures*, Lassieur et al., 2007-2015), *Time Traveler* (Reit et al., 1986-1987, *Time Machine*, Preiss, 1984-1989, *Histoires à jouer—Les Livres à remonter le temps*, Cayla and Pecau, 1986-1987), geographical subjects (e.g., the series *Earth Inspectors*, Packard et al., 1988-1990), and scientific subjects (e.g., the series *Explorers*, Preiss, 1987). However, there are also gamebooks on literature subjects that are useful in secondary education (see, e.g., Campbell Webster, 2007; North, 2016; Heartfield, 2018; Theodoridou, 2019 for examples playing with masterpieces by Austen, Chaucer, Shakespeare, and Homer).

Beside reading, designing gamebooks and branching narratives (BN-DBL) is also a useful method to foster knowledge acquisition (see Noutch, 2018). By encouraging students to develop their settings, characters, and narratives, educators can bring (group of) learners to

become familiar with specific topics before creating a branching storyline. Educators can modulate the amount of knowledge they expect learners to investigate and attain. For simple tasks, they may require students just to write a story on familiar subjects. For more engaging activities, they could ask students to investigate in depth the topic, and manifest rich understanding of it in the branching story.

Especially these writing activities seems suitable to enhance knowledge about sustainability. Section 4.2 showed that sustainability knowledge requires understanding the fundamental views and concepts on (i) sustainability, (ii) equity and justice, and (iii) the environment from CA1, (iv) complexity theory, (v) the interconnections between the discussion on sustainability, the identification of solutions, and ideological worldviews from CA2, (vi) the evolutionary path of complex systems from CA3, and (vii) the principles and practices behind political decision-making processes, (viii) the nature of political system, and (ix) political responsibility and accountability from CA4.

Educators interested in promoting sustainability knowledge can prepare lessons and lectures on one (or more) of these domains, then ask learners to write branching narratives that explore its conceptual richness in a realistic or fictional scenario.

5.2 Skills

Reflection on sustainability competences clarified that many skills are fundamental for sustainability education. We hereby discuss how teaching and learning with gamebooks and branching narratives can promote a variety of these.

5.2.1 Debating, and critical thinking

A first group of sustainability skills refers to the capacities of (i) discussing and comparing different values (CA1), and (ii) critically assessing provided evidence (CA2). Gamebooks usually incorporate social and ethical dilemmas that require readers to make choices based on either moral considerations, or the critical evaluation of some evidence. This makes them a valuable tool to strengthen those skills, even with very young learners.

For instance, reading a gamebook in front of the classroom asking the pupils to discuss the reasons in favor of the different opportunities for action is an effective exercise for improving debating, and critical thinking. Moreover, if pupils were first requested to write (even short) branching narratives—that is, the BN-DBL approach—on choices and dilemmas more closely connected to social, economic, and environmental crises (see section 5.1), having them playing each other's stories would support, at the same time, knowledge acquisition on sustainable development as well as critical thinking and debating skills.

5.2.2 Collaboration, negotiation, and collective decision making

Gamebooks can significantly develop sustainability skills connected to social interaction such as the capacity to work as a team (CA4), to negotiate solutions (CA4), to converge as a group on a shared decision (CA4), and to engage in democratic decision making (CA4).

As a first suggestion, collective reading of gamebooks can prompt learners to debate and align on one decision to continue the reading.

For instance, in *Dustville Dilemmas* (Strategic Education Research Partnership, 2016), the player takes on the role of a new mayor in a small southwestern town in the US, and is called for deciding between supporting the local economy and preserving local fauna and environment. Any choice can be good or bad, but the reading of the story in front of the classroom will certainly prompt shared discussion on significant choices that affect environmental sustainability. As an alternative, asking pupils to keep track of the choices they make while reading individually can be a method to prompt self-reflection and discussion in final debriefing activities—rather than collective decision making.

As a second suggestion for promoting teamwork, collaboration, and communication skills, educators can make learners write gamebooks and branching stories (BN-DBL) even in large groups such as the classroom. With this respect, Angiolino (2004, pp. 141–156) proposes an interesting method for the gamebook collective writing. (1) The learners read together a very short branching novel at least twice to discover and try different endings, thus familiarize themselves with the genre. (2) The teacher asks the learners to decide the genre for their branching story and promote discussion on its commonplaces. Ideas and commonplaces are collected on a whiteboard or similar space for further reference. (3, optional) Learners investigate the genre and the topics that may become a subject for the story. (4) The teacher facilitates the group's interaction to define the story's hero and main plot(s). (5) The teacher facilitates the group's interaction to sketch the story's branching on a whiteboard as a tree (as the one displaying by Figure 1). (6) Once the whole tree has been defined, labels or random numbers are assigned to each node. (7) Nodes are assigned to different (groups of) learners, who thus write different paragraphs and sections of the story. (8) The paragraphs are assembled in a text… and a new gamebook has born!

5.2.3 Analysis skills and dealing with complexity and alternative futures

Important sustainability skills include the capacity to analyze complex scenarios (CA2), to frame sustainability challenges from different perspectives (transdisciplinarity) (CA2), and to envisage alternative futures (CA3). Significantly, gamebooks can help educators foster these skills.

Branching narratives essentially rely on proposing choices and dilemmas to the reader. Thus, reading a gamebook requires the player to maintain an open orientation toward the story and the future, to navigate the ambiguity of information and the uncertainty of the outcome, and to keep in mind all factors that may be relevant to make the best decisions.

The writing of gamebooks and branching narratives (BN-DBL) can also contribute developing the capacity to deal with complex information and alternative futures. First, writers must create a story by planning and developing its different sections and storylines, which requires design thinking. Second, they must consider the user experience and map the interconnections between the different parts of the story (system thinking, CA2.1). Third, by asking learners to incorporate logical puzzles and scientific challenges in the stories, educators can also help them develop a richer understanding of scientific principles and mathematical reasoning, which ground the science of complexity. With this respect, stories exploiting science fiction and time-travel themes (e.g., *Time Traveler*, Reit et al.,

1986-1987; *Time Machine*, Preiss, 1984-1989) are particularly apt to make learners play with scientific concepts, the representation of the future, and (un)sustainable development.

5.2.4 Problem solving, decision making, and risk management

Sustainability competences require fundamental capacities related to making effective decisions: identifying what actions are more relevant for a desired outcome while managing uncertainty (CA3), proposing alternative pathways for sustainability (CA 4), acting in line with shared narratives on sustainable futures (CA4), and working collectively in sustainability change processes (CA4).

These competences are significantly aligned with the skills a pupil will exercise while reading a short gamebook—or also designing it within a BN-DBL approach. Indeed, the most distinctive feature of branching narratives is perhaps the readers' obligation to make decisions to carry on with the adventure. Playing gamebooks forces the reader to solve conflicts with all available means, to take decisions and bear with the consequences (problem solving and decision making). Many times, informing evidence is incomplete thus making decisions also requires the reader to take chances, to act promptly even in the face of uncertainty and unforeseen events, and to learn as they go (risk management).

A good example of a gamebook prompting these skills with respect to policy making (CA4) is *Can You Brexit?: Without Breaking Britain* (Morris and Thomson, 2018). The gamebook puts the reader in the role of the Prime Minister (PM) of the United Kingdom, starting from the day following the Brexit vote and extending to the conclusion of the Brexit process. Throughout this journey, the player faces a multitude of challenges, including managing the National Health Service (NHS), addressing the Exit Fee, handling immigration issues while ensuring the protection of residency rights, and navigating EU Trade Talks. The player capacity to deal with complex decisions affects their score on four dimensions (Authority within the party, Economy of Britain, Goodwill of the EU, Popularity with the voters), and decides the conclusion of the story.

In proposing gamebooks in educational contexts, teachers can rely on the intrinsic features of branching narratives to familiarize learners with problem solving, decision making, and risk management. They should encourage students to explore different storylines, make choices, and experience various outcomes, to navigate through the game world, and adjust their approach and strategies based on feedback.

5.3 Attitudes

Although transferring attitudes is hardest than providing knowledge of supporting skill acquisition, teaching and learning with gamebooks and branching narratives can also provide deep existential experiences, thereby impacting the development of personality traits and dispositions.

5.3.1 Empathy and sensitivity to sustainability issues and values

A first area of sustainability attitudes refers to the specific attitudes oriented to the values connected to sustainability: (i) the concern with the impact of one's own action, or (ii) the systemic consequences of

environmental crises on the future, and (iii) a sense of empathy and connection to humanity and the future generations from CA2; the commitment to (iv) protecting and restoring nature (CA1), as well as to (v) adopting more sustainable life habits and decreasing material consumption (CA3).

Gamebook-based learning activities can significantly contribute to modifying these attitudes. Although playing is usually an autotelic activity—that is, without other scopes than its direct exercise—designers also create games that convey some meanings ("games for change"), deal with mature or adult content ("serious games"), or are expressly dedicated to education ("edutainment," see Rieber, 1996; Deterding et al., 2011). These games are more prone to challenge the player, create doubt, and raise questions therefore to develop familiarity and empathy for sensitive issues (including sustainability).

With this respect, many (mostly digital) branching narratives have explored the troublesome experiences of people living in challenging scenarios. For instance, both *Bury me, my love* (Maurin, 2017) and *Syrian Journey: Choose your own escape route* (Thornton, 2015) tell the story of Syrian refugees as they undertake a perilous journey to safety in Europe. In *Twenty Months* (Molinari and Pozzi, 2016), a collection of short dialogues and branching stories staged between 1943 and 1945 during the Italian Resistance to the Nazi-fascist dictatorship, the player takes choices for many characters, who collectively represent the lives of many Italians struggling with war. *Depression Quest* (Queen and Lindsey, 2013) is an interactive fiction with mature content telling the struggles in everyday life of people suffering from depression The fiction depicts depression levels affecting the reader's choices. It shows other sufferers of depression that they are not alone in their feelings, and to illustrate to people who may not understand the illness the depths of what it can do to people.

Educators can prompt gaming activities on selected branching narratives like these to raise pupils' interest toward specific scenarios, and prepare the terrain for informed discussion. Alternatively, they can also ask learners to take inspiration from real-life stories to create similar branching narratives that deal with sustainability. By engaging with these serious scenarios, learners gain social awareness, empathy, and understanding of diverse perspectives.

5.3.2 Cognitive attitudes

A second area of sustainability attitudes refers to cognitive stances such as (i) being focused toward objective and exhaustive systemic analysis (CA2), (ii) being rigorous and systematic in thinking about the future (CA3), (iii) having the willingness to adopt a long-term perspective (CA3), and (iv) trusting scientific and empirically-informed perspectives (CA2). Some of these also refer to creativity in thinking both inside and outside the box, and adaptability in making unusual choices (both from CA3).

Educators can best promote these attitudes by creating complex project-based learning (Condliffe et al., 2016) assignments, that require learners to manage the whole process of designing and creating a minimally complex branching narrative—that is, the BN-DBL approach. Managing a large project will require learners to develop persistency in aiming at a complex goal, determination and coherence in managing their learning and background knowledge, flexibility and adaptability to modify the initial idea to the challenges that emerge along the process. By creating in group complex stories,

pupils will take ownership of their learning experience, explore different possibilities, and develop innovative solutions.

The case of BN-DBL presented in section 3 exemplifies this proposal. Teachers and educators can follow the indications proposed there to foster the acquisition and development of cognitive sustainability attitudes such referring to coherence, adaptability and flexibility in thinking and planning.

6 Conclusion

Can teaching and learning activities based on games promote prosocial behavior and positive social change? We have answered looking at the educational potential of gamebooks and branching narratives. The detailed report described in section 3 has clarified a practical method based on story design and creation (Branching Narrative Design-Based Learning, BN-DBL) that teachers and educators can use to introduce playful activities with gamebooks in their courses and classes. We discussed the method in the context of teaching game design in higher education but, with proper adjustments, the same strategy can also be adapted to any subject including sustainability in primary and secondary education as well as non-formal education.

Our case study has been insufficient to argue that learning activities with gamebooks and branching narratives do foster prosocial behavior and positive social change. To support this conclusion, section 4 has introduced the substantial claim that aiming at positive social change implies supporting education to sustainability. Under this assumption, we have then clarified what sustainability competences are.

Thus, section 5 has investigated how game-based pedagogies focused on gamebooks and branching narratives can promote the acquisition of these competences. To this aim, we have explored the variety of strategies that educators can follow to promote learning with gamebooks and branching narratives, and identified several examples specific to the development of new knowledge, skills, and attitudes connected to sustainability.

Significantly, our analysis shows that BN-DBL—i.e., the method based on introducing gamebooks in the classroom by asking group of learners to design and write original branching stories—looks as one of the most promising activities of using gamebooks to promote sustainability, as it has acknowledged that BN-DBL has many benefits. Indeed, it:

- Is very flexible, and can be adapted to any sustainability subject and skill;
- Involves the learners in complex design activities that can strengthen creativity, analysis skills, systemic and critical thinking, and an open attitude toward research;
- Engages learners in group activities thereby promoting social skills such as cooperation, negotiation, debating, and collective decision making;
- Creates intellectual products that can extend their life beyond the walls of the educational institutions, and reach other areas of society.

In addition, BN-DBL enjoys many features typical of more contemporary student-centered learning paradigms. It:

- Engages the learners in game-design and playing learning, which are more prone to increase motivation and satisfaction (Nousiainen et al., 2018; Ryan and Rigby, 2020);
- Instances project-based learning (Condliffe et al., 2016), i.e., a methodology that—although focused on the cognitive "heads-on" domain (see Sipos et al., 2008)—is still recognized as effective for sustainability education (Lozano et al., 2017);
- Provides a social dimension to the learning experience, giving it meaning and direction (Kumpulainen and Wray, 2003);
- Asks learners to investigate new topics, and reinforces active knowledge acquisition (Prince, 2004);
- Can foster learning, meta-learning, and personal development, hence promote the ultimate level of sustainability education, that is, "transformative" learning (Mezirow, 1978; Sterling, 2001).

In conclusion, this article has explored the significant educational potential of gamebooks and branching narratives, which remains largely untapped and awaits full exploration. In particular, game-based learning activities with gamebooks and branching narratives—and, more specifically, the method of asking group of learners to design and write original branching stories, which we herein identified as Branching Narrative Design-Based Learning (BN-DBL)—represent an effective strategy to promote sustainability competences in formal education. We hope our contribution will inspire school teachers and educators, who want to engage their learners in sustainability education, with a practical method to use gamebooks and branching stories in their educational context.

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The order of the authors' names is arbitrary because this article is fully collaborative. In compliance with specifications of the Italian Ministry of University and Research, we clarify that IM has written sections 2 and 3, and MF sections 4 and 5. The authors have equally contributed to the writing of the introduction and the conclusions.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

MF: Conceptualization, Formal analysis, Methodology, Supervision, Writing – original draft, Writing – review & editing. IM: Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing.

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The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/feduc.2023.1335605/full#supplementary-material

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