What is "Learning" in Serious Game Jams? A Systematic Literature Review

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Abstract: Game jams, events where participants collaboratively create games within a limited time frame, have gained popularity as engaging and educational activities. Numerous studies highlight learning as a significant motivator for participation, positioning game jams at the intersection of pedagogy, design research, and game studies. A systematic literature review (SLR) using the PRISMA 2020 method was conducted to explore the state-of-the-art in game jams and game-making co-creation practices amongst Cultural Heritage Institutions, Creative Industries, Higher Education Institutions, and Youth Citizens in the context of X project. Out of the 68 eligible sources, 10 explicitly addressed the learning goals associated with game jams and constitute the sample of this study. The present article focuses on exploring what conceptualizations of learning can be found in the sources and how that learning process was structured throughout the game jams; specifically, what participants are learning, the methodologies employed, and how the learning was measured. A comprehensive understanding of the educational potential of game jams is important for game jam organisers as well for formal, non-formal and informal Education. The results show that although some articles use game analysis or questionnaires to measure learning, these results are not analysed or presented in depth. Furthermore, it could be noticed that serious game jams, explicitly designed to teach something, usually featuring more time consuming, due to the specific nature of an added layer to game jam: a serious theme that needs to be learned by the participants but also reflected in a game for educational purposes. This underscores the potential use of (adapted) game jams to promote learning regarding social issues, culture, or science in an engaging and dynamic way. This article reflects on those processes and the different conceptualisations of learning that can be found in sources that tackle this topic with regards to Serious and Cultural Game Jams.

Keywords: Game-based Learning; Game Jams; Serious Game Jams; SLR

1. Introduction

Learning is a multifaceted process, shaped by several foundational theories: behaviourism, cognitivism, constructivism, humanism, and connectivism. Constructivism, particularly highlighted by theorists Vygotsky and Piaget, provides valuable insights when it comes to games. Piaget's cognitive constructivism focuses on the individual's construction of knowledge, asserting that humans must actively create their understanding (Piaget, 1953). In contrast, Vygotsky's social constructivism emphasises learning as a social activity, relying heavily on collaboration and interaction (Vygotsky, 1978). Recent research underscores the integration of game analysis and production in education, enhancing contemporary media literacy and other skills (Costa et al., 2020; De Freitas et al., 2013). Studies show that games can support multiple literacies (Gee, 2008; Buckingham & Burn, 2007) and foster creativity (Caperton & Sullivan, 2009). Parekh et al. (2021) explored how Systems Thinking and Model Building for Learning could engage young people in producing games on complex scientific themes. In a workshop with youth,, a board game about water pollution was developed. The ideation process involved participants using Model Building to grasp the scientific concepts before designing the game. They simplified the science behind water pollution and applied it to their game design, aiming to disseminate knowledge effectively. Considering this, the present study is part of a broader systematic literature review (SLR) on game jams and collaborative game-making practices across various sectors, including Cultural Heritage Institutions, Creative Industries, Higher Education Institutions, and Youth, within the framework of EPIC-WE project. The research aims to explore learning through Serious Game Jams (SGJs) by addressing these questions: 1) What are the conceptualizations of learning according to SLR sources? 2) How did organisers structure the learning process?

1.1 Related Literature

Game jams have been emerging as an innovative tool for learning, due to its potential for networking skills, adaptability, as well as the ability for innovation and creativity in game-making. These events are known for their time-constrained characteristics, ranging from 24-28h, where participants gather in groups to develop games relating to a specific theme (Kultima 2021). Kultima (2021) observes that for many jammers, the interest in

participating in game jams lies in the ability to expand the design and game-making process, a crucial skill in the context of commercial game development, not typically cultivated in traditional educational settings. Arya (et al., 2013) also emphasises that this flexibility is valuable not only in game development but also as an opportunity for jammers to develop innovative and more efficient methods of organisation and brainstorming that align with the time constraints faced. Beyond the development of game making skills, a new type of game jam, usually described as Serious Game Jam (SGJ), which has been organised by DiGRA JAPAN (Digital Games Research Association) since 2014, focuses on exploring the use of games as a tool for learning about social issues, such as gender inequalities (ref), cultural heritage (ref) or science (ref). Here, a 'serious' thematic constraint is added in comparison to events such as the Global Game Jam (GGJ), that also have a thematic constraint though normally unrelated to the topics approached by SGJs. When considering SGJs, which explore more complex themes, some studies, which will be further analysed in the present paper, emphasize the importance of preparing the theme with the participants, engaging them in extra educational activities and giving them time to internalise it.

2. Method

This article features a selection of sources stemming from the results of a Systematic Literature Review (SLR) conducted under the EPIC-WE project that followed the PRISMA 2020 guidelines (Paget et al., 2021). The review gathered sources from three scientific databases (ACM Digital Library, b-on, and JSTOR); declaring as 'external sources': items from four other digital libraries where the agreed upon search formula could not be used, and individual articles that were either selected from the project's original proposal or suggested by project partners. All the sources had to have been written in English. For the search time frame, the articles should be published between February of 2002 (since the first game jam had been organized) and February of 2023. The search formula used in the scientific databases is shown below:

- ("game jam*" OR "game mak*") AND ("youth" OR "young" OR "teen*" OR "adolesc*") AND ("culture" OR "cultural" OR "communit*" OR "innovation")

Exclusion Criteria	Name	Description
Ex.C. 01	Revision by peers	Not peer-reviewed
Ex.C. 02	Publication Date	Published before 02/2002 or after 02/2023
Ex.C. 03	Language	Not available in English
Ex.C. 04	Availability of Full Text	Full text is not available
Ex.C. 05	Document Duplication	Duplicate record
Ex.C. 06	Ongoing	Describes a project that is ongoing
Ex.C. 07	Not Related	Theme is not relevant to the review
Ex.C. 08	No Game Jam	Does not mention game jams
Ex.C. 09	No Game Development	Does not mention game development
Ex.C. 10	No Youth	Focuses on ages below 16 and above 25 years old or does not specify
Ex.C. 11	No Culture	Does not mention cultural themes and/or heritage
Ex.C. 12	No Innovation	Does not expore practices that are explicitly innovative

Figure 1: Exclusion Criteria for the SLR screening process

The first screening of the SLR (title and abstract) using Rayyan software identified 1,455 sources, including 87 from external sources. The exclusion criteria are shown in Figure 1. Cohen's kappa for this screening, calculated on 12% of the records, was 0.74, indicating "substantial" correspondence (O'Connor & Joffe, 2020), with an average agreement rate of 95.57% and a disagreement rate of 4.43%. The second screening (full text) was conducted with *NVivo 14*, resulting in 82 articles, with 68 included in the review. No automation tools were used. This screening's Cohen's kappa was 0.76, also indicating "substantial" correspondence, with average agreement and disagreement rates of 98.12% and 1.88%, respectively. From the SLR, 10 sources were selected to be analysed in the context of this paper, and were codified as "learning in serious or cultural game jams." This paper will analyse these sources regarding their conceptualizations of learning, descriptions of the learning process, and the logistics of the SGJs they report on.

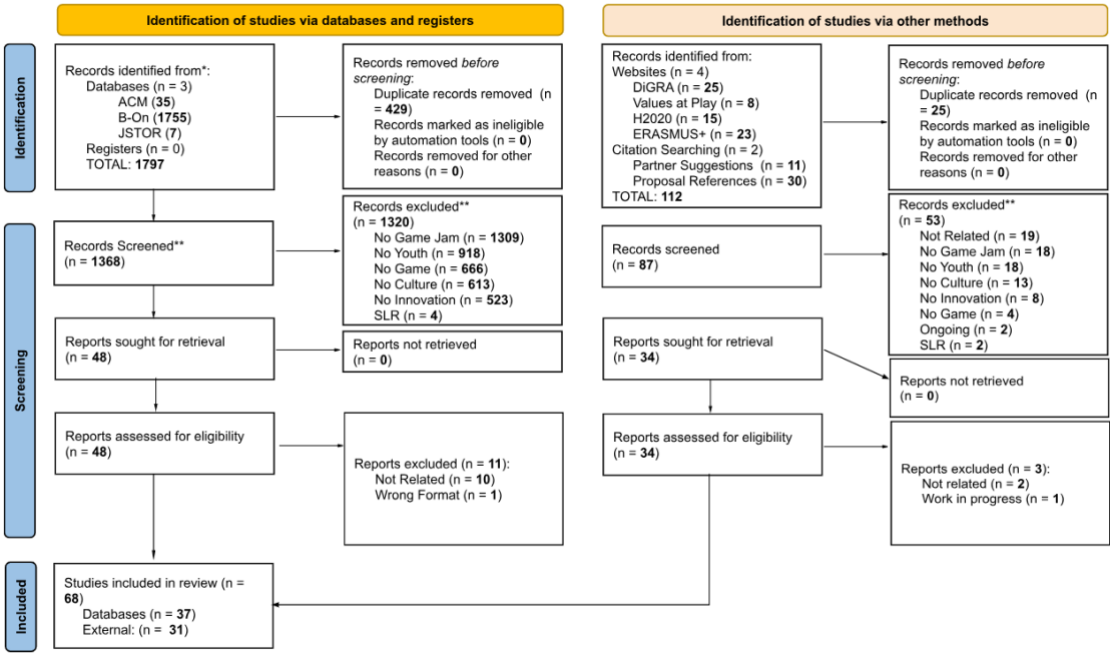

Figure 2: PRISMA2020 flow diagram including sources from both scientific databases and external sources.

3. Results

From the 10 sources selected and analysed in this article, represented in table 1, eight of them were codified as referring to conceptualizations of learning, but only one of them specified a learning paradigm, namely, the constructionist approach (Study 7). Most of the conceptualizations of learning found were related to game jams – for example, collaborative and cooperative learning (Study 4). Furthermore, seven articles were codified as "measuring learning", although this is not discussed or analysed in depth in most articles. The learning process and the logistics behind the serious game jams are described in five articles, focused mostly on the time of the jam, the learning activities prepared, and the relationship between facilitators and participants.

Table 1: 10 selected sources for analysis that address learning in game jams

Nº	Reference	Serious Game Jams Logistics	Main Ideas
1	Arya et al., (2019)	Pré-event workshops and educational activities Week-long game jams	The authors develop the "GGJ-Next Curriculum" adapted for educational purposes, focused on learning.
2	Aibara et al. (2022)	The SGJ operation organizes the logistic of the game jam in 3 phases: 1) the preparation phase 2) the lecture phase 3)the development phase	The authors present the SGJ operation manual, adjusting the game jam logistics to serious themes.
3	Aibara et al., (2020)	The 8th SGJ was divided into two sessions: a study session, with lectures about the theme delivered by specialists and a development session, focused on the game-making	The authors noted the difficulty in adapting the logistics of the GGJ to the specificities of the SGJs, given the different objectives of each. They highlight the importance of preparing a manual to guide the organizers of SGJs.
4	Contreras-Espinosa & Eguia-Gomez, (2022)	Four dimensions of learning in game jams: 1) cooperative; 2) project-based; 3) problem-based; 4) collaborative;	The authors highlight game jams as great opportunities for the cultivation of essential skills, embodying principles of co-creation, co-production, and co-design.

5	Danilovic et al, (2022)	A game jam aimed to explore the lived experiences of participants with opioid addiction, focusing on inclusivity for marginalised groups, by inviting these populations to take creative control of the game production process.	The authors highlight the transformative potential of game design in fostering community, resilience and self-insight among young-adults grappling with addiction.
6	Laiti et al. (2021)	A five day cultural game-jam had a cultural program of two days to get acquainted and involved with the Sámi culture. The theme of the jam was defined together with the participants. The game jam took place in a cultural center.	The authors shed light on the role game jams can have in passing down traditional knowledge, using the case of Sámi Game jam as a tool for the revitalisation of indigenous history in the context of Sámi culture.
7	Petri et al., (2019)	The article argues that game jams are well-suited for constructionist learning, providing a context where students can work as a team to solve challenges and expand their knowledge.	The authors introduce the constructionist approach, connecting it with game jams, advocating for an active and experiential way of learning.
8	Preston (2014)	Preparation on the theme and support began a week before the start of the jam. Experts were present throughout the last day to do follow-up sessions. Information leaflets on the subject were made available at the facility during the entire event.	The author recommends logistical specificities to be taken into account in the case of Serious Game Jams.
9	Ramzan and Reid (2016)	The NPJ benefited from a team of researchers working with developers, allowing for a diverse range of expertise to be shared. This collaboration allowed developers to utilise researchers' knowledge for prototype design and development, while researchers' work was translated into games through effective communication.Having key stakeholders may have generated a different breadth of prototypes due to the addition of new expertise, perspective, and agenda	The authors developed the noPILLS Jam (NPJ) focused on water pollution solutions. The games, targeting various audiences, reflected the potential of game jams in generating rapid prototypical evidence for research initiatives.
10	Schrier et al (2021)	The game jam aimed to enhance perspective-taking, identity exploration, and connection to others through game design, encouraging students to express themselves creatively.	The study discusses the implementation of a game jam in public schools in Nigeria, focusing on identity exploration and perspective-taking for students, teaching empathy and compassion.

3.1 Game Jams for Learning

In recent years, there has been a growing acknowledgment of the intertwined relationship between learning and enjoyment, a concept elucidated by study 1. The authors posit that the human brain is inherently wired to derive pleasure from the act of learning, suggesting that they are symbiotically linked. Many studies highlight game jams as valuable learning opportunities, with learning being a primary motivator for participants. Study 7 introduces the constructionist approach, connecting it with game jams, advocating for an active and experiential way of learning. According to this framework, learning is most effective when individuals construct personal knowledge through engaged participation, rather than passively acquiring information. This approach of hands-on experiences fosters creativity, independent thinking and problem-solving skills.

Study 4 states that the type of learning that takes place in game jams does not differ much from the one that occurs in typical educational environments, identifying four types of learning: cooperative, project-based, problem-based and collaborative. Cooperative learning happens through task division among participants, especially in teams with diverse skills, requiring autonomous work while maintaining team cohesion and collaboration. Project-based learning involves participants solving their challenges with facilitator support, fostering autonomy and frustration management. This aligns with problem-based learning, characterised by creative problem-solving for new challenges. Lastly, collaborative learning, one of the most identified types of learning in game jams, concerns the process of learning through collaboration between two or more participants

to achieve a common goal: creating a game. This process is present throughout all the game jam, and doesn't relate only to participants, but the facilitators, who also engage in processes of collaboration, particularly during pitch sessions.

When it comes to learning in SGJs, study 9, through the "noPILLS" game jam, explores the theme of water pollution, with three games produced. One of them, Sewer Seeper, focuses on water filtration, with the main goal being to shoot the micro polluting elements that appear and threaten the environment. Along with players learning about micropollutants as they eliminate them, a quiz is introduced between levels to test the knowledge acquired. This study introduces the concept of learning extending beyond the game jam, when games are made publicly available. Study 5 highlights the transformative potential of game design in fostering community, resilience and self-insight among young-adults grappling with addiction. Study 10 explores the use of a game jam to learn about empathy, with two games being developed: Forgiveness, which focuses on exploring conflicts and learning to forgive others, and Togetherness, which focuses on tolerance, acceptance and perspective taking. Another growing field explores game jams' potential to teach and produce culture. Study 6, involving the Sámi Game Jam, aimed at revitalising indigenous Sámi culture, produced six cultural games. For example, Lost Memories presents the player two conflicting worlds: the cultural traditions that represent the Sámi community and their heritage, and a new modern world, which implies leaving behind their memories, traditions and history. Another game, Rievssat, puts the player in the role of a Northern Finnish ptarmigan bird whose habitat, that used to provide safety and a home, becomes increasingly dominated by colonising forces, leaving it uninhabitable and the bird feeling alienated from his birthplace. The authors considered that the production of culture happened in a literal sense, reflecting the way Sámi Game Jam successfully served as a tool for cultural revitalization. Considering the sources analysed, it's possible to identify a common notion: that game jams have the potential to be dynamic learning ecosystems where participants engage in multiple learning processes – ranging from game making skills to learning about cultural heritage.

3.2 How was the Process of Learning Structured?

When considering the specific goals of SGJs, it's important to adapt the game jam format to the learning outcomes desired. Study 3 notices that the conventional framework for Global Game Jams (GGJs) is not a good fit for SGJs. When comparing the logistics of both, the authors call attention to the differences in theme and the games' design. While in GGJs the participants are free to interpret a general theme as they wish, and develop games for entertainment, in SGJs the theme is usually followed by lectures with specialists and the pressure of dealing with a real-world issue. This is reflected in the game design, as participants need to conduct research and share ideas and doubts with specialists to develop a game that is entertaining, but also educative, which makes it the key process of the entire event. While in GGJs there is a theme revealed to the participants at the beginning of the game jam, followed by the game design, in SGJs the theme is revealed through several means, and includes preparation such as live lectures on the topic. After knowing the theme, for the participants to start the game design, they need to research extensively about the theme, which requires a greater effort and time than in GGJ. Taking this into account, study 3, which implements the 8th SGJ, inspired by the SGJ operation manual (see study 2) was divided into two sessions: a study session and a development session. In the first stage, a workshop was organised by a specialist and a presentation of the theme was made, allowing participants six days to reflect on the theme and to do their own research and prepare for the game ideation. Study 8 explores the logistics of SGJs through the noPILLS Jam, which focused on health. A week before the jam, participants attended a lecture by a health expert, which allowed the participants to gather more knowledge about the topic, ask questions and autonomously do a follow-up of the theme. After the start of the jam, experts were also present on the last day to provide support. In addition, throughout the game jam, information leaflets on the subject were made available at the facility, which the participants found very useful. The author emphasises the importance of having experts present throughout SGJs to foster collaboration and enhance learning. Although follow-up sessions with experts were beneficial, most teams were focused on completing their games due to the time constraints, neglecting deeper reflection on the theme. Therefore, the author suggests preparation before the jam to allow for more time and dedication to the theme. Additionally, evaluating games based on their educational value alongside typical criteria encourages participants to focus on developing games with educational purposes, not just on design and playability. Based on the experience, . The author proposes a model for SGJs that includes extensive expert access before and during the jam, through workshops, information sessions, and participation in pitching and presentation sessions. The importance of facilitators is also explored in study 9, where the authors, through the lessons learned from the noPILLS game jam, already mentioned, emphasise the importance of collaboration and the benefits of having topic experts as facilitators. These experts transferred their knowledge to participants, who then expressed it through their games. Study 1 adapted game

jams for educational purposes, especially for youth, resulting in the "GGJ-Next Curriculum, that explores the learning outcomes that should be achieved during game jams. This curriculum targets cognitive outcomes (creativity, innovation, problem-solving, logical thinking), skill-based outcomes (programming, design, narrative, audio, visual arts), and affective outcomes (motivation, confidence, friendship, networking, fun). They found that adapting the GGJ for younger participants enhances learning by addressing their needs. For educational game jams, the authors also recommend pre-event workshops and activities weeks before the jam and suggest week-long jams to produce more games. Study 6 highlights the importance of preparing the theme and creating a learning environment in game jams, as shown in their game jam focused on Sámi culture. There was a focus on preparing the theme, enabling participants to get involved and take ownership of the topic, and fostering communication, sharing and learning with and from representatives and participants of Sámi culture. By the start of the jam, participants were expected to be familiar with the theme, allowing for greater exploration of Sámi culture. The event lasted 5 days, with the traditional 48-hour format, but with three important variations: before the start of the jam, a cultural program was held, which included two days at the beginning to get acquainted and involved with Sami culture, culminating in a day dedicated to Sámi culture. Throughout the event, it was a priority to include representatives of Sámi culture among the participants, as their lived experiences and knowledge were essential for the creative and narrative process, and for interpreting and using their culture in the games appropriately. The importance of “feeling” the culture reflected on the choice of the facility - the game jam took place in a cultural center (Áilegas), but at the same time there was a traditional Sámi tent (lávvu) which served as a place for daily reflections, pitching sessions and follow ups (ibidem). This approach shows that SGJs, which aim for educational purposes, need to meet different participant needs, allowing more time for internalising and learning without the typical 48-hour pressure.

4. Discussion

The learning process in SGJ’s must be adjusted to the needs of the theme and the participants. In this sense, study 2 presents the SGJ operation manual, which states the importance of going beyond the 48-hour format, preparing and evolving the participants on the theme. Study 8 advocates for pre-jam preparation through lectures and workshops to facilitate meaningful reflection and suggests evaluating games based on their educational value alongside traditional criteria. Similarly, study 6 emphasises theme preparation in a Sámi culture-themed jam, extending the event to include cultural immersion activities. In both studies, the extended format and expert involvement enhanced the participants' understanding and self-confidence in exploring the themes. These findings underscore the transformative potential of structured learning within serious game jams. When considering how learning is assessed in serious game jams, some studies measure it by the number of games created as a result of learning, while others conduct pre and post-game jam surveys to track changes in the awareness of the issue, but the results are never explored. For example, in study 6, with the Sámi Game Jam, the authors did follow-up questions throughout the event, to see if the participants were managing to familiarise themselves with the topic. These questions focused on the educational aspects of the game jam, especially regarding Sámi culture and the participants' expectations for the educational impact of their game – however, the results are not addressed by the authors. Subsequently, a textual analysis of the games was also carried out, with the aim of understanding the educational impact of the game and measuring the occurred learning. In the “noPILLS Game Jam” (study 9) the learning process stems from the way all games were "considered as successful demonstrations of the potential that serious game jams can offer in developing rapid prototypical evidence for research initiatives" p. 541. However, there is no measurement of learning, as the authors acknowledge that no research has been done to confirm the validity of this learning, and that this is only an assumed outcome of the project. This lack of measurement and description of the learning processes found in the articles reflects the need to reinforce the importance of this process when it comes to SGJs. Due to the complexity of organising, preparing and ensuring not only that the learning of the theme happens, but also that the game-making reflects that while contributing with new knowledge, a bigger and clearer communication of the process, challenges and achievements between different organisers may contribute to a stronger framework and outcomes related to SGJs. Furthermore, since the articles focus on learning, there should be a deepening and exploration of this thematic, given that some articles do not refer to any theory or conceptualization, using the term in a generalised way. For the future, to inform the learning process, this article suggests a bigger focus on measuring the learning outcomes beyond the number of games produced, and making those results available and discussed in the article. To talk about learning outcomes, one must know 1) what was the participants’ initial educational level on the subject; 2) what instruments must be used considering the needs of each team and subject; and 3) what are the expected outcomes.

Some limitations in this study can be found. The first limitation stems from the fact that the articles analysed come from an SLR with a more general theme, as part of a broader project, not taking into account other articles that could be relevant to discussing this thematic. The second limitation comes from analysing only 10 articles, which is not representative of the broader research done in the topic of learning in Serious Game Jams. For the future, it is recommended to create a framework adapted to SGJs, which considers specific educational approaches used in the context of these game jams, the expected learning outcomes, how to prepare the theme and the participants, and which methodologies should be used to measure the success of this learning process.

5. Conclusion

Considering the first research question, "What are the conceptualizations of learning according to SLR sources?", through the analysis of the sources, it was possible to conclude that there isn't a unique approach to learning applied to game jams – instead, the authors highlight the multiplicity of formats of learning and conceptualizations that can be thought of when talking about game jams. Study 7, for example, introduces the constructionist approach to game jams, highlighting how they provide a context for participants to construct their knowledge in collaboration and interaction with others. Furthermore, the results found that some articles referring to learning in game jams do not specify any educational approach or theory, reinforcing the need to define clearer specific approaches. Considering the second research question, "2) How did organisers structure the learning process?", when analysing the logistics of SGJ's, most articles reinforce the need to prepare the topic with the participants, extending the usual time-frame, introducing experts on the topic as facilitators, and doing educational activities. Given that it is expected that in SGJs participants will not only be able to present a playable prototype, but that this prototype will reflect a real social problem, there is an added responsibility to treat the topic with time and less pressure.

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