Game Creation in Youth Media and Information Literacy Education

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ABSTRACT
This proposal presents the preliminary findings of GamiLearning (2015-2018), a research project that aims to promote critical and participative dimensions of Media and Information Literacy (MIL) in children through the creation of digital games. The project presents an innovative approach by arguing that MIL can be promoted through the process of creation and development of videogames. Students aged 9 to 14 years old from Portugal and Austin, Texas (USA), participated in the study that included an intervention at schools, based on a constructivist/project-based approach. Fieldwork was conducted in four schools and a MIL questionnaire, based in a theoretical framework, were administered before and after the project's intervention. Results from the four schools indicate statistically significant differences between pre and post questionnaires, considering MIL skills in general, and in several groups of skills, namely Operational Skills, Editorial Skills, Digital Identity Management Skills, Critical Media Literacy, Learning and Social Interaction.

Keywords: Media and Information Literacy, Media Education, Digital Game Creation, Children, Project-Based Learning.

INTRODUCTION
Media Literacy and Games as a Reflexive Tool
The way we communicate and make meaning in a mediatised world demands a bundle of literacies, often referred to as *media literacy*, *information literacy*, *visual literacy*, *multimodal literacy*, *computer literacy/ICT literacy*, *media and information literacy* (Drotner & Erstad, 2014; Gutiérrez-Martín & Tyner 2012). Regardless of definitions and approaches, these multiple literacies open critical discussions about the changing relationship of literacy and learning.
There is a generalized consensus that "promoting and enhancing media literacy, for child and adult populations, is of growing importance, in a context of digital media convergence and a highly complex media and information ecology" (Livingstone, Bulguer, & Zaborowski, 2013).

Frau-Meigs (2014) states that core MIL skills include operational skills (including coding and computing), editorial skills (including multimedia writing-reading-producing and mixing) and organisational skills (including navigating, sorting, filtering, evaluating) are central to media education in a digital age. Beyond its importance as an individual skill, media literacy opens social and cultural dialogue that emphasizes its plurality. People don't create meanings individually, but as members of "interpretive communities" (Livingstone, Wijnen, Papaioannou, Costa, & Grandio, 2013) where literacy practices evolve.

The developments during the last three decades within the fields of both media and education studies have encountered controversy, yet "point toward a common ground of shared interests around people, practices, and processes in using digital media in different contexts and for different purposes" (Drotner & Erstad, 2014). One of the main controversies in media studies and education studies can be found in the discourse about the impact of digital media on audiences and learners as it relates to a dichotomy of risks and affordances. These can be seen in dialogue related to risks and moral panics versus celebratory visions of technology as the catalyst of social change (Drotner & Erstad, 2014). Games, particularly video games, have long been associated with these controversies and seem to have a common ground with perspectives for media studies and education studies with a focus on their social uses by users/audiences/learners. As a result, a common assumption is that learning experiences occur in diverse learning environments, whether they are designed as formal, informal, physical, or virtual educational spaces (Drotner & Erstad, 2014).

Video games, particularly the multiplayer games, involve collaboration, competition, sharing, searching for information on chat rooms and web sites (Gee, 2008) and these practices enable the development of communities of learning. In addition, research that investigates the cognitive learning potential of game play, game analysis and game design increasingly demonstrate the ways that games can support other literacies (Buckingham & Burn, 2007) and creativity (Caperton & Sullivan, 2009). A growing body of evidence supports the integration of game analysis and production across the curriculum (Freitas & Ott, 2013) and, as a pathway to enhance and support students' contemporary media literacy skills and knowledge. Games can be integrated in teaching in several ways, such as using commercial titles, developing games with specific learning goals (serious games) or leading the students to create their own games (Van Eck, 2006). If the latter has traditionally been practiced as a way of teaching programming and problem-solving skills (Ibid.), it also has been used "to teach about games as a cultural medium in their own right, just as we teach about film or television or literature" (Buckingham & Burn, 2007).

In addition to these approaches, game play and creation can be used as a reflexive tool that children can use for establishing and developing their own critical understanding of media. First, some have noted that critical media literacy requires the development of reflexive knowledge: a child needs to know a topic to be able to produce a related game. Secondly, in the process of game creation, children engage in collaboration and peer-learning, which has been shown to support critical literacy and learning across the curriculum (Salen & Zimmerman, 2004; Torres, 2009). Third, game design and content creation also provide children with opportunities to integrate and reflect on their everyday media experience.

While most researchers agree that games can support learning, they also agree that more empirical research evidence is needed to support the integration of "good games" in learning environments (Landers, 2014). The problem is that defining the quality of game models and design activities in the classroom requires a balance between the role

of pedagogical design and the engagement factor in game design that include game mechanics, interactivity, engaging narratives, immersion and fidelity (Freitas & Oliver, 2006).

Game Creation in Youth Education

The disparate missions and practices for youth media production in formal and informal education sectors complicate consensus about the pedagogical design, integration and assessment of video games in the learning environment. This can be seen in disparate educational goals for game play and game creation. Nonetheless, relevant bridges between formal and informal practices are beginning to take shape through the emergence of innovative models and strategic partnerships that use design thinking to contribute to new spaces for learning. One example can be seen in the rise of Do It Yourself (DIY) and Maker Movement trends across the United States. These community-based centres provide important testbeds for "learning by doing" through the creative uses of technologies in project-based and participatory work for all ages. Also known as "tinkerers," groups of makers of all ages ignore the constraints of formal education as they work with new media and technologies in the design studio tradition of artists and industrial entrepreneurs. Through creative production, these dynamic models offer engaging and relevant affinity spaces that support access to equipment, mentorship, peer learning and creative risk-taking for students of all ages. They create a version of Gee's "situated, embodied learning spaces" where students of all ages can mod, hack and create their own products, including video games. Makerspaces provide incentives to revive the project-based, creative and collaborative learning that has faded in public education (Santo, Peppler, Ching, & Hoadley, 2015). In many ways, the DIY and Maker affinity groups hearken back to amateur photography and movie clubs, ham radio operators, and hands-on industrial arts classes from the 20th Century. They also work in tandem with traditions for analogic and digital youth media production in community-based settings across the United States. Most of these youth development and arts organizations seek to provide youth with a voice in their communities through storytelling in narrative and documentary formats using a wide range of analogic and digital production, usually as moving image productions, but sometimes as radio and print products.

Nonetheless, even in community-based spaces that support youth production in the media arts, there is evidence that the creation of video games is still marginalized. A national survey of youth media organizations in the United States found that only 11% of the organizations ($N = 51$) support video game development in their media production programs. One explanation is that youth media organizations, especially in the informal education sector in the United States, struggle to find the capacity to meet a growing demand for their services due to low funding, staff recruitment and retention and barriers related to work with underserved communities (Tyner, 2015).

Opportunities for game creation in Europe demonstrate similar patterns. Most of the content production by youth in formal or informal learning does not include videogames creation. One explanation could be that videogames are more resource intensive than other media. In addition to hardware and software, teachers and professional trainers do not often have the specialty knowledge for game creation. In Portugal, since 2008, an initiative to promote Scratch, a simple game creation software, has been directly promoted to public schools (Costa, Jorge, & Pereira, 2014). This initiative allows people without any previous knowledge in programming languages to create games to support the development of creativity and logical, mathematical and scientific reasoning. In addition, the sharing of media objects (images or pieces of code, or object

behaviours) among Scratch online community members has been shown to have positive outcomes that support social competencies.

Blum-Ross (2015) notes that struggles with the sustainability of youth media organizations are also reflected in their diverse aims, purposes and pedagogical practices in the field. This provides an additional layer of complexity for researchers and educational designers.

The cross-mentoring connections between formal educators and youth media practitioners during the school day is a core component for successful design for media production programs (Tyner, 2015). Beyond the traditions of youth media production, new testbeds for innovation are beginning to provide models that contribute to research, scalability and best practices for the integration of games for learning.

A growing body of research provides evidence for the uses of game play as a pedagogical tool in interdisciplinary learning environments. However, the research related to the impact and potential of game design and creation as a pedagogical tool is relatively limited. A literature review of recent research in the area of game-based learning conducted through the use of SAGE Publications, ACM publications, iEEE, Science Direct, EBSCO, Web of Science and Google Scholar and a final sample of 52 peer reviewed articles published from 2010-2016, revealed that only 19 sources in 52, mention learning theories in their experiments, 'Serious Games' were the most referred in sources (38) and 'Game Creation' was only mentioned in 2 sources (Costa, Tyner, Henriques, & Sousa, 2016). This project argues that the design and creation of video games can work as a reflexive tool to promote the critical understanding of media that is necessary to foster MIL skills. Therefore, an intervention in schools was designed including a curriculum for students and teachers as well as a methodology to measure its impact on students' MIL.

The GamiLearning project aims to develop critical and participative dimensions of MIL in students, through digital game creation in a collaborative learning environment. The present study explores the effectiveness of a digital game creation project-based approach for the development of MIL skills, in a formal schooling context.

METHODOLOGY

Research Design and Procedure

The research design includes an exploratory multi-case study with four schools, three schools located in Lisbon and one school located in Austin, with students aged 9-14, enrolled in Grades 5-7. Four classes participated in the study in 2016-17. A curriculum was developed based on online digital identities, online security, data protection and encryption, game design, game mechanics and animation, using Scratch software as the primary game engine.

Since documented research on MIL scales for children was either not found or was based on media access and usage, GamiLearning developed a MIL questionnaire to measure attributes related to the learning goals. Results from this questionnaire will also be used to analyze and refine the survey for future use. Baseline and endline data was collected and compared through pre and post surveys to measure the impact of game creation activities on MIL learning in the selected classrooms. In addition, the project used participatory observation during the classes to evaluate the impact of the curriculum on children's MIL skills and in future studies will use content analysis of the videogames created by children, as well Social Network Analysis, to measure students' interactions on SAPO Campus, data that can complement observations. In the present study, the pre and post questionnaires' results will be explored, to document the efficacy of this intervention. The research design is presented in Figure 1.

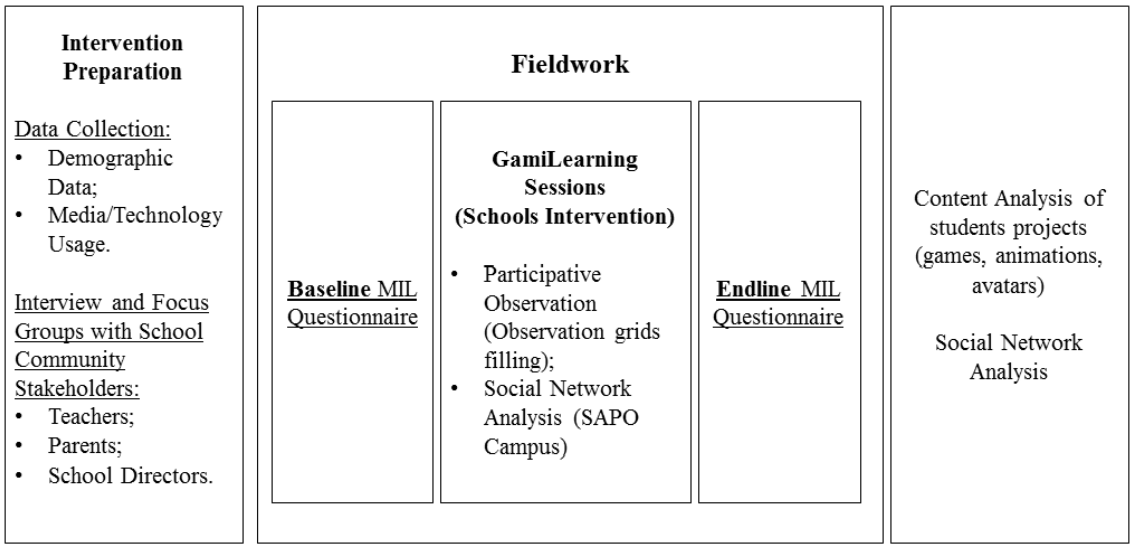

Figure 1. GamiLearning Research Design

Sample

The sampling selection was based on the convenience and availability of the schools to participate in the study. The directors of each school received a formal invitation and two representatives of the research team went to the schools to explain the project. Six invitations in total were sent, three schools in Lisbon and one school in Austin agreed to participate in the study. From those, only one class in each school was available to join the project (5th grade in Lisbon, 7th grade in Austin). All schools and parents signed confidentiality and informed consent agreements. In addition, in the United States, formal approval was acquired from the school district's institutional review board, and from the University institutional review board. Three schools in Lisbon and one school in Austin joined the study. A total of 58 students, 70,6% male (N = 41) and 29,4% Female (N = 19), aged between 9 and 14 years old (M = 10,68; SD = 1,384). Full sample characterization can be found in Table 1.

Table 1. Sample Demographics, by age and gender

	Age	Gender	
		Male	Female
Total Sample (N = 58)	M = 10,68 SD = 1,384	41	19
School 1 (N = 20)	M = 9,70 SD = 0,470	10	10
School 2 (N = 6)	M = 10,00 SD = 0,000	6	0
School 3 (N = 19)	M = 10,26 SD = 0,653	12	7
School 4 (N = 15)	M = 12,80 SD = 0,775	13	2

Participant Schools

School 1 is a private school located in a business district of Lisbon. It bases its pedagogy on innovation, mainly framed as arts education, but also with an emphasis on sports activities and digital literacy. Its educational mission promotes learning by doing, stimulating the collaboration and participation of all stakeholders. The students' age

range is between 0 (nursery) and 15 years old (ninth grade in Basic School in Portugal). In most cases, this established a continuous enrolment from early childhood to adolescence for most students in this school. A total of 20 students in the 5th grade in this school participated in the GamiLearning project, 50% male (N = 10) and 50% female (N = 10), between 9 and 10 years of age (M = 9,70; SD = 0,470). From October 2016 to March 2017, the students met once per week in a school atelier called GamiLearning, to participate in the training, for 90 minutes.

School 2 is a private school located in a historic area of Lisbon. It bases its teaching method on the promotion of excellence, through a humanized pedagogy, which promotes citizenship. Community-based partnerships are encouraged for student projects. Students from nursery to high school (ages 1-16) attend the school. The sample of participants for this school includes six students from 5th grade, all male and all with 10 years old. From October 2016 to April 2017, the students met once per week in a school atelier called GamiLearning, to participate in the training for 45 minutes.

School 3 is a public school, located in Great Lisbon and classified as an educational territory of priority intervention, by the Portuguese Ministry of Education, meaning that it was considered an area in need of urgent intervention to reverse drop-out trends, to create a supportive environment for learning in a low-performing school with high needs. (MEC, 2012). The school's educational goals are based on the integrating capacity of public schooling, with a focus on valuing social and cultural diversity. Students in Grades 5-9, between age 9 and 15, attend the school. Nearly half of the students (46.6%) are covered by the school's social aid system. The sample for this schools consisted of 19 students from the 5th grade who were involved in the project, 62.3% male (N = 12) and 36.8% female (N = 7), aged between 9 and 12 (M = 10,26; SD = 0,653). From October 2016 to June 2017, the students met once per week in a Director's class to participate in the training for 45 minutes.

School 4 is a public middle school, for Grades 6-8, located in the city of Austin, Texas (USA) and managed by the Austin Independent School District. The student to teacher ratio at the school is 14:1. School 4 students' age levels range from 11-14 years of age. In the 2016-2017 academic year, the school enrolment was 615 students who identify as African American (5.7%), Hispanic (60%); White (29.4%), Asian (2.1%) Pacific Islander/Native American (0.2%) and Two or More Races (2.9%). The school does not collect parental data related to income and education levels. The indicator used for student economic levels is the number of students receiving free or reduced lunch prices. 62.8% of the 615 students at the school are classified as "economically disadvantaged", and approximately 65% receive free or reduced lunch prices. This school's sample consists of 15 students in Grades 7 and 8 who participated in the project, 86,7% male (N = 13) and 13,3% female (N = 2), between 12 and 14 years of age (M = 13; SD = 0,775). The students' GamiLearning activities took place in a computer lab as part of the computer science class, twice per week. Each course is 95 minutes.

Curricula and Intervention

The curricula for this educational intervention were designed within the theoretical framework of Media Literacy and considering inputs from the area of game-based learning, game design and constructivism. Accordingly, the main pedagogical approach was project-based learning, from a comprehensive perspective, where students are engaged in the learning process through the investigation of solutions to real problems (Blumenfeld, Soloway, Marx, Krajcik, Guzdial, & Palincsar, 1991). The two teachers (Portugal and Austin) agreed upon the overall concepts for the GamiLearning

curriculum and the main goal of this intervention was to support students to create a game about online identity management, including e-presence and online security. The classroom tasks were designed to support the operational, editorial, organizational skills and knowledge for students' management of their online identities.
The main thematic areas approached were: managing online identities (e-presence); online security; internet; collaborative learning platforms (SAPO Campus and Google First); and Game Design and Game Mechanics. These issues were discussed in a connected manner, allowing students to construct their own understanding and knowledge of MIL, through experiencing things and reflecting on those experiences. The total amount of time spent with each curricula component is represented in Table 2.

Table 2. Curricula and amount of time per content

Curricula Content	Duration in Portuguese Schools	Duration in School 4
Managing Online Identities (e-presence)	4h30m	5h00m
Online Security	3h00m	6h00m
Internet	4h30m	0h00m
Online Collaborative Platforms (SAPO Campus or Google First)	4h30m	1h00m
Scratch	7h00m	4h00m
Game Design and Mechanics Review and Critique	3h30m	2h00m

An example of the pedagogical approach in the learning process is the robot activity, a group project using a robot as an artifact that 'speaks' only computer language. Students need to make a list of objects (food and kitchenware) and to create an algorithm with the precise instructions for the snack preparation by the robot. Since the robot needs precise instructions, as it is in programming languages, the group presents the algorithm to the teacher and colleagues that give immediate feedback if there are bugs: incomplete instructions, for instance. The students were very engaged while performing the activity and reacted very well to suggested corrections. "Learners must experience success and failure not as reward and punishment, but as information" (Bruner, 2016).

MIL Measurement

The MIL questionnaire was developed to measure the impact of the Gamilearning project and its effectiveness, based on a set of competencies for Media and Information skills. The key theoretical frameworks for these MIL skills are based on the previously discussed work of Frau-Meigs (2014), as well as the sociocultural (Livingstone et al., 2013); and digital identity management components (Costa, Sousa, Rogado & Henriques, 2017) related to MIL skills.
The questionnaire was operationalized as a self-reported MIL assessment and as such, it evaluates the children's perception of their own skills. The questionnaire items are designed for a 5-point Likert scale, a format that is familiar to children of this age (Mellor & Moore, 2013). It has been argued that the scale format is not compatible with the dichotomous thinking organization for children of this developmental age (Piaget, 1954). Nonetheless, evidence shows that the use of simplified Likert scales (3-points), versus a dichotomous format, do not necessarily change the results in a statistically significant way, (Chambers, 2002). In the MIL questionnaire, each item was designed as a declarative sentence and sentences were associated with colours to increase

respondents' efficiency and understanding as they completed the questionnaire (Mellor & Moore, 2013).

The questionnaire was composed of two main parts. The first part was related to MIL Skills and abilities used to analyse operational, organizational, editorial (Frau-Meigs, 2014) and digital identity management skills (Costa et al., 2017). It was composed of 24 items to measure knowledge and familiarity with these skills on a 5-points Likert scale of 1=Low/5=High. The second part of the questionnaire was related to the sociocultural components of MIL skills (Livingstone et al., 2013) and intends to operationalize a wide set of competencies that also includes knowledge and attitudes (UNESCO, 2016). It was composed of 12 items, mainly addressing Critical Media Literacy/Critical Media Analysis, Learning and Social interaction, to be answered in a 5-points Likert Scale, ranging from 1 (Totally Disagree) to 5 (Totally Agree).

To provide more detailed analysis of the results, we evaluated each curriculum component, analysed possible differences, and grouped the variables into related categories. This grouping process is illustrated in Table 3. In the questionnaire administration, items within each part were randomized, to control possible effects related to answering items within a certain issue grouped (Lavrakas, 2008).

Table 3. Measurement of MIL Skills

Part I	
Operational Skills	Create an avatar
	Build a website
	Create an app
	Use software programming tools
	Develop levels in a videogame
	Create a blog
Organizational Skills	Use calendars and/or reminders to organize my schedule
	Select the words and symbols that give me the best results when using a search engine
	Select the results that are most reliable and useful to me when doing an online search
	Use a secure process to store my passwords
	Bookmark and catalog websites and articles online so that I can find them later
	Organize my work, documents, images or photos in my computer
Editorial Skills	Find inspiration in the work of others to do my own creative

	Share my creative work online
	Use charts, graphs and pictures to explain my ideas
	Use presentation software and digital tools to share my work
	Use editing software to create, edit and share photos or videos
	Use software programming language(s) to create some of my work
Digital Identity Management Skills	Think carefully about the way I represent myself online
	Assume different roles when playing games online
	Manage an online profile to share my interests, ideas, photos or videos
	Understand the terms and conditions for the sites that I use before I click “accept.”
	Protect my computer and mobile devices with strong and safe passwords
	Protect my data when using public computers, logging off my accounts and not storing passwords.
Part II	
Critical Media Literacy	I can identify bias in the media
	I can recognize inaccurate or unethical information on the internet
	Media can be used to spread false information about people, places and things
	I can recognize spam messages and do not respond to them
Learning	I learn to use software by playing around and making mistakes
	Media can help me better understand some of the topics I study in school
	I use media to help me solve problems and make decisions
	I interact with other people online to learn new things
Social Interaction	I use digital media to stay in touch with my friends or family

	I interact online with people with the same interests as me
	I share my work and ideas online
	I play videogames that require collaboration with other players.

RESULTS AND DISCUSSION

The data was analysed using the Statistical Package for Social Sciences (SPSS), version 22. These results and subsequent qualitative data will also be used to refine the data collection instrument, for future use. Results from the MIL questionnaire, pre and post results were analysed to test whether there are significant differences between the results collected before and after the project's intervention. Wilcoxon nonparametric test was used as it was considered the most powerful and reliable for this sample (*N* School 1 = 20; *N* School 2 = 6; *N* School 3 = 19; *N* School 4 = 15; Shapiro-Wilk for all test variables < .05).

Table 4. Analysis of differences in MIL questionnaire, before and after the project's intervention, for four schools (*N* = 58)

		Pre *M*	Pre *SD*	Post *M*	Post *SD*	*p*
Part I	MIL Total (all items considered)	3,08	0,789	3,38	0,739	.004
	Operational Skills	2,38	0,831	2,76	0,854	.017
	Organizational Skills	3,29	0,942	3,52	0,861	.157
	Editorial Skills	2,94	0,857	3,19	0,984	.052
	Digital Identity Management Skills	3,36	1,036	3,70	0,873	.007
Part II	Critical Media Literacy	3,51	1,067	3,79	0,87	.049
	Learning	3,00	1,051	3,35	0,917	.012
	Social Interaction	3,26	1,066	3,58	0,969	.015

Within the context of the theoretical framework and the eight categories used for this MIL measurement, it is possible to verify the existence of statistically significant differences, between pre and post test results in six of those groups. Results for the total MIL questionnaire were statistically significantly (p = .004) higher in the endline assessment (M = 3,38; SD = 0,739) than in the baseline assessment (M = 3,08; SD = 0,789). Statistically significant differences were also found for Digital Identity Management Skills (p = .007), Learning (p = .012), Social Interaction (p = .015), Operational Skills (p = .017) and Critical Media Literacy (p = .049).

Digital Identity Management was the central theme of the curriculum, therefore the increase in post-test could be explained by the time and activity organization devoted to digital footprint, online representation and security. Students were invited to create avatars and internet pirates and to reflect about them. They were able to make a distinction between 'bad' and 'good' pirates, being the first ones in students' words "identity thefts" and the last ones people that 'crack data for good' and with a contribution to the internet evolution. In what respects online security, students were invited to play the "secret alphabet": a collaborative and competitive game, where groups of students acted as messengers, others as receivers and others as intruders, simulating the exchange of messages on the internet and therefore acquiring basic notions of security. The messages are encrypted by the messengers with an analogue Caesar's cipher wheel, delivered to receivers that decrypt them using the same device.

As it could happen on the internet, the intruders intercept the messages and try to decrypt them. If the intruders were able to decrypt the message first they win the game, otherwise don't. A reflection by students about the weakness of this simple cipher followed the activity.

The statements on group "Learning" of the questionnaire (Table 3) are related with mediated learning on a digital environment and have a deep connection with the intervention where students explored Scratch by themselves at home and with peers and teacher in class. The usage of SAPO Campus platform, a social network, enabled students' interaction and peer learning. Since outside GamiLearning class students did not use computers and the internet frequently, there is a positive link on the intervention and post-text results on "Learning".

In what respects to "Social Interaction" one of the statements is related with the role of media in interactions with the group of proximity (friends, family) and in this case it's expected that after one academic year, because their age has increased, students are more able to use digital media to be in touch with relatives as well to play multiplayer videogames: "I play videogames that require collaboration with other players". Nevertheless, the usage of the internet during classes, sharing the stories and videogames developed on Scratch and benefiting from Scratch remix to their own projects, only happened during the GamiLearning classes.

Considering "Operational Skills", the differences can be possibly explained by the activities developed in a considerable number of sessions. Avatar creation, using online images and avatar makers, making draws on Scratch, publishing content at SAPO campus were widely approached. Moreover, higher values in the item related with software programming tools can be explained by the relevance that the development of games and animation in scratch assumed. Related to this game remixes, using premade code pieces in scratch, and game development can explain increases in the item "Develop levels in a videogame". A considerable number of students also created blogs in SAPO Campus, and the ones who didn't get familiarized with the concept by reading and watching content published by colleagues.

Considering "Critical Media Literacy," the higher value in the endline assessment could possibly relate to the promotion of reflexion and critical thinking across the several tasks conceptualized for children. Still, this is an area where abstraction capability is very necessary and, given the age range in Portuguese sample, these results will have to be triangulated with the observation data.

It's not a surprise that only residual significant differences were found for "Editorial Skills", since four items in six are not related with the intervention or the school curriculum, in particular "Use software programming language(s) to create some of my work"

No statistically significant differences between pre and post were found for "Organizational Skills" and a possible explanation is that all the statements in this category are not related with GamiLearning class activities and youth activities in general, besides using search engines. However, the statements about to search and find information (Table 3) are related with knowing the best keywords for a particular search and being able to recognize the reliability and usefulness of results, what was not part of the intervention.

CONCLUSION AND FUTURE WORK

GamiLearning is an action-research project that aims to develop critical and participatory dimensions of MIL for youth, through collaborative learning experiences and digital game creation. This study explores the effectiveness of a digital game

creation, project-based learning approach for MIL skills acquisition, in a formal schooling context. The study conducted a comparative analysis of questionnaires completed by students before and after the project's intervention. Results indicate promising links between digital game creation and MIL development. Statistically significant differences in results for several groups of MIL skills were found in the questionnaires completed by students after participation in the Gamilearning project. Although the results indicate some areas of success for this type of curriculum in the development of MIL skills, there are also some limitations in the present study. As expected, results indicated more developed skills for some items in the questionnaire before the intervention, one common limitation of self-reported data in pre- and post-questionnaires can be seen in the study.

Another limitation of comparative analysis for this study is the different contexts between Portugal and Austin, such as culture, the educational system, prior learning, duration of the coursework, and sample demographics. In addition, the difference in duration for the intervention at the Portuguese schools and Austin, due to the usual constraints in recruiting a school with the characteristics and capacity to support the research.

Barriers in the educational system were also found such as difficulties in the implementation of research projects in school due to the necessary regulations and permissions required for ethical research with children and adolescents, the lack of physical affordances in classroom design to accommodate group work, especially group work with computers or a computer lab. Finally, the logistics of project-based work is even more difficult with the large number of students in each class, as it is in most educational settings.

Finally, the GamiLearning fieldwork offered an opportunity to field test a data collection instrument to measure MIL learning after participation in game creation activities. It is important to note the general limitations of self-reported, pre- and post-survey data as a confidence factor in the pre-survey. In other words, respondents can overestimate their skill and knowledge in the pre-survey and then adjust it more accurately in the post survey, resulting in a potentially lower result. Also, effects of social desirability can be considered in this type of questionnaire.

Observational and interview data will be used to refine the data collection instrument for future use.

As the next step in our research, results from the MIL questionnaire will be integrated with the analysis of qualitative data gathered from class observations and content analysis of the videogames created by students. The additional data is expected to provide nuances and contexts for curriculum design and impact measurement that will inform classroom practices in game creation for media literacy learning.

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