IDNs in Education: Skills for Future Generations

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Abstract. Interactive Digital Narrative (IDN) literacy and authoring skills are being gained too late along a typical student's educational journey and only by a niche subset of learners while such skills are crucial to consume modern day media communications reporting on complex phenomena from multiple perspectives. This paper acknowledges the impact of technology on teaching and learning methods as well as the current status of digital media in education and uses them to explain how IDN can be used to teach K-12 subjects with the aim of helping students attain IDN literacy skills. It also suggests ways to expand IDN literacy by adding authoring skills. The paper connects these overarching goals with current initiatives in establishing IDN literacy and authoring skills in the K-12 curriculum and presents short-, medium- and long-term objectives towards the above two aims.

Keyword: Interactive Digital Narratives · K-12 Education · literacy · authoring

1 Introduction

The World Economic Forum is intent on providing better education and new skills to 1 billion people by 2030[1]. Amongst their initiatives is the *Schools of the Future* report [1] which identified eight critical characteristics of high quality future-proof learning.

[1] https://initiatives.weforum.org/reskilling-revolution/

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Among these are *global citizenship skills*, *innovation* and *creativity*, *technology*, *personalized* and *self-paced learning*, and *accessible* and *inclusive learning*. With today's complex narratives and underlying problems, traditional storytelling techniques fall short of conveying the multiple perspectives necessary to understand the systemic nature of modern society. On the other hand, Interactive Digital Narratives (IDNs) are better equipped to provide an experiential understanding of the complex narratives of modern society [2]. On this background, we might wonder why exposure to IDN literacy and authoring education is delayed until the final years of undergraduate study or even at postgraduate level after many years of education through single-perspective narratives. If K-12 education (i.e. Kindergarten to 12th Grade) has unilinear 'creative', informative, and argumentative writing as the pillars of literacy, why are IDNs not part of every learner's skill set in order to help them cope with modern society and its complex narratives?

During the Association for Research in Digital Interactive Narratives (ARDIN) general meeting held as part of the ICIDS online conference in Bournemouth, 2020, an idea emerged to push IDN literacy further down the education curriculum to help produce IDN analysts, scholars, and designers that can assist future generations cope with the complex realities that surround them. This idea attracted the interest of IDN scholars engaged in education as well as IDN students and undergraduate alumni who focused on IDNs in their final year projects, to form a committee and push this idea forward.

In this paper, we present the vision of the committee and work of its members seeking to engage with the ICIDS community whose collaboration we seek to push IDNs down the K-12 curriculum. We first contextualize the use of IDNs in education within related research. Then we describe some existing applications of IDNs in K-12 education that serve as starting points and further motivations for the committee. Finally, we share the short- and long-term objectives that were discussed during meetings of this committee in order to spread this initiative further and invite conversations that may further steer the direction of this endeavor.

1.1 Aims

The committee presents two general aims that have short-term and long-term objectives. The aims revolve around K-12 skills in consumption (experiencing and reflecting upon) as well as authoring IDNs. Both are elements of IDN literacy [2] and have been shown as being highly interlinked [3]. They should thus be addressed together while clearly demarcating these roles and their contributions in education. These aims are:

Aim #1: To identify ways how we can use IDN to teach K-12 subjects in order to help students attain skills in consuming IDN,

Aim #2: To identify ways how we can teach IDN skills to K-12 students in order to help them attain IDN authoring skills.

2 Related Research

Novel methods and technology are regularly introduced in formal educational settings. Examples include "flipped classrooms" [4] and "blended learning" [5, 6] methods, as well as the introduction of laptops and tablets alongside gamification and adaptive learning systems. At the same time, new technology by itself does not result in improved education. Instead, new technology needs to be paired with matching educational concepts and implemented together.

2.1 Teaching with Technology

The flipped classroom shifts the content delivery to home studying before and after the lesson, leaving contact hours for problem solving and application of the main ideas [4]. Blended learning combines face-to-face learning with online learning [5] allowing learning to scale out while providing individuals with the ability to pace their learning [6], especially with the development of MOOCs in 2008 [7] and the response to challenges offered by the COVID-19 pandemic [8], particularly in non-Western cultures [9, 10]. The use of technology in and outside the classroom facilitates novel approaches, for example gamified learning, by incorporating game elements and mechanics into the learning process to build upon the learners' experiences with such technology for leisure and entertainment purposes. Gamification includes the use of educational video games, simulations and interactive activities designed for more immersive and enjoyable learning. Gamification does not always succeed however, with at least one research study identifying negative effects such as loss of performance, declining effects across time, indifference and undesired behavior [11]. Indeed, introducing technology into the classroom is not just about adding a 'magic ingredient'. It turns out that the use of technology in the classroom often does not live up to the hype and rhetoric surrounding it, hampered also by the teachers' lack of alignment of pedagogical models with the technology's potential [12].

Thus, adopting technology in education requires careful planning and design of impactful applications of interactive techniques afforded through technology that allows for self-paced and personalized learning. Adaptive learning systems use technology and algorithms to build a model of goals, preferences and knowledge of each individual learner in order to personalize their learning experience [13, 14]. These systems assess a student's strengths and weaknesses and provide customized content, feedback, and recommendations to optimize their learning journey. While such systems lend themselves more easily towards computer science programmes as the subject being taught is native to the medium through which it is being delivered, technology is a means that is available in all subjects. Indeed, with educators of different subjects across the globe having to adapt and shift their lessons online during the COVID-19 pandemic [15–18] and general applicability of technology in education has become apparent. In addition, as technology pervades all aspects of daily life, an increased need for digital literacy exists for the 21st century citizens, and many related initiatives already exist in the educational sector [19].

This context presents a fertile ground for the application of IDNs to education at different levels and in different subjects. Building on the flipped classroom concept, IDNs can replace or complement recorded lectures and video clips with interactive

experiences of the subject matter, allowing the learner to delve deeper into subject areas allowing for a personalized learning experience. Blended learning affords a guided navigation of the subject matter as students are led through the educational content in class for more in-depth and slow-paced revision outside the classroom. Using the fictional nature of IDN artifacts to present simulations of real-world scenarios, these works can provide a safe exploratory experience of the subject matter at hand, be it a physics experiment, a biology dissection lesson or a historical re-enactment of a cultural ceremony. Through their interactive nature, IDNs offer an adaptive learning platform that can provide personalized learning opportunities that can be customized according to education level and accessibility requirements.

However, IDNs offer opportunities beyond those offered by gamification, role playing, and other types of simulations in education. IDNs as systemic, dynamic, and reactive narrative expressions [2] can make use of these approaches, by combining and extending them under a unified perspective. IDNs, through their ability to portray multiple perspectives, can provide holistic representations of a subject matter without trivializing its complexity or falsely projecting a singular truth. IDNs afford replays that reveal more information with each session, allowing the student to engage deeper with the subject free from the bias of a singular perspective. Thus IDNs should be given priority in the classroom as they help create future citizens with the ability to negotiate the complex times ahead [2].

2.2 Teaching about IDN

Teaching with IDN is only one side of the equation. The other side is teaching about IDN, enabling a critical understanding of the advantages and limitations of this mediated expression by educators and learners alike. This involves engaging with a number of key IDN artifacts that are appropriate for the learners' age and subject, but also includes IDN authoring to gain full IDN literacy. This aspect has been a gap in education and members of the committee have been particularly active to address it. Their work is presented next.

IDN use in education can integrate and adapt learning principles to this novel context. Interacting principles of IDN pedagogy design include identifying digital media affordances as relevant to learning capacities and challenges in relation to societal circumstances [20]. Implementing innovative learning activities with such interacting principles may be more feasible than formal mainstream educational settings. However, interactive education may be also transferrable to mainstream education. Examples in this regard are dynamic storytelling workshops across countries separated by a decade of wars which illustrate this integration of digital affordances to address learning capacity/challenges in relation to societal circumstances [20].

Education in divided societies, such as during and after war, political revolution, or changing socio-political ideologies can draw on teens' intense social motivations, willingness to experiment, curiosity about diversity, and desire to right wrongs they perceive in society, as well as their often-unchallenged abilities for symbolic manipulation such as required with digital media creation. Dynamic storytelling workshops occurred in community education centers across the former Yugoslavia with a range of digitally-mediated narrative and other communication activities, implemented across the settings

and adaptable to each local situation, such as with the diverse access to computers, internet connections, and young people's availability to engage in several hours of activities [21]. The workshops involved a variety of interactive digital tools for verbal and visual narrating, creating surveys, publishing, letter writing, and research. Although not IDN authoring in regard to using the full facilities of the interactive medium, the activity nevertheless shows the potential of related narrative-focused activities. The compilation of different youth collaborative expressions fostered non-linear sense making about challenges to youths' lives in their post-war contexts. One hundred thirty-seven youths in Bosnia and Herzegovina, Croatia, Serbia, and the United States participated in several activities to create local newsletter entries about problems and possibilities in daily life from the youth perspective.

A IDN authoring activity designed and implemented with science undergraduates [22] is also adaptable for use with students from middle school onward, depending on their prior work with digital media. To study the development of IDN design learning by undergraduates without prior digital design experience, a two-hour workshop was devised which involved a brief introduction to Twine[2] and subsequent turns in which participants designed an IDN and shared their experience playing a peer's emerging IDN design. Transcriptions of the player experience reflections and the final IDN designs indicated the students' ability to learn basic IDN design tools and the benefits from a player's reflections about the design [22]. College students were able to work through the process relatively independently, and younger students who may need a structured environment could benefit from doing such a process in lab or classroom settings. This will be possible in the near future based on an online implementation [22].

Several studies show the relevance of linking IDN consumption skills with IDN authoring skills, namely the analysis and interpretation of an IDN with its creation. For instance, in their study conducted in France with seven teachers in literature classes (11 year old to 16 year old students), Bouchardon and Brunel [3] show the mutual reinforcement of the analysis/writing links (links between IDN consumption skills and IDN authoring skills). The authors emphasize that the experience of production is called upon more than for other types of works. The conduct of a pedagogical sequence, with its various sessions, shows that the creation of a short IDN is an important part of the sequence and is directly linked to the resources worked on during the analysis phase of an IDN. The tools used are very different, and a considerable diversity of creative practices and formats can be observed: e-books, slideshows, hierarchical or branching narratives created with Twine, etc. But for each teacher, the chosen format is directly associated with the digital piece studied. The teachers aimed to encourage their students to transfer the various contents and forms studied in the digital works to their own production, and to do this using similar writing forms to those of the studied works. Overall, three main notions were transferred from the students' analysis of the IDNs to their own creation of an IDN: a sensorial and multimedia universe, animation and temporality (the different ways of playing with the notion of time), interactivity and author-reader relationship (between control and loss of control, grasp and loss of grasp).

[2] https://twinery.org/

2.3 Current Status of Digital Media in Education

Teaching digital media and incorporating digital media in education has become increasingly important in recent years. By integrating these aspects into the curriculum, schools can equip students with the skills, knowledge, and competencies necessary for success in the digital era [23]. These skills empower them to become responsible, informed, and ethical digital citizens who can navigate, contribute, and thrive in our increasingly digital and interconnected world.

Digital Media and Literacy Skills. Digital Media is currently used as a tool to teach traditional literacy skills (reading and writing) in many K-12 schools. There are different regional and national standards around the globe for literacy, but oftentimes reading and writing falls under one of the following categories across disciplines: expository, argumentative, and creative writing. For example, the United States has adopted the Common Core State Standards (CCSS), a set of academic standards created to streamline learning across the States in Mathematics and English language arts/literacy in which the following Text Types and Purposes are specified for Grade 6:

> "*Write arguments to support claims with clear reasons and relevant evidence.*
>
> *Write informative/explanatory texts to examine a topic and convey ideas, concepts and information through the selection, organization, and analysis of relevant content.*
>
> *Write narratives to develop real or imagined experiences or events using effective technique, relevant descriptive details, and well-structured event sequences.*" [24]

The anchors of CCSS literacy instruction involve developing informative, argumentative, and narrative writing skills. The focus is placed primarily on augmentative and informative writing, with narrative writing supported in the younger grades but ancillary in the upper levels.

Digital Media is used as an aid for teaching these literacy skills, and is recognized within the standards of the CCSS framework itself under Production and Distribution of Writing for Grade 6:

> "*Use technology, including the Internet, to produce and publish writing as well as to interact and collaborate with others; demonstrate sufficient command of keyboarding skills to type a minimum of three pages in a single sitting*" [24]

The CCSS places importance on using technology to produce and publish writing as well as to interact and collaborate with other students [25]. Therefore, digital media can be used as a tool to bridge the gap between more traditional methods of teaching and the contemporary student, making literacy skills more accessible to 21st century learners. Examples include digital filmmaking as a means to teach writing skills, the creation of customized learning materials through iBook Author, and more.

IDN has the potential to further support all three of these strands of traditional literacy, especially through the production and distribution of writing. Specifically, it can boost the production and publishing standard beyond simple "digital" aids, and instead help

students become more creative and less linear in their writing process. Streamlining standards can lead to rigid writing structures, and IDN provides a means of countering this and encouraging higher-level learning.

At the same time, IDN's specific affordances and aesthetic qualities would be underused in this capacity. As a digital native form of expression, it can boost production and publishing standards beyond a simplistic use of "digital aids", and instead help students become more creative and explore interactive and dynamic forms of narration as means of representation for their own projects. In addition, streamlining standards can lead to rigid writing structures, and IDN provides a means of countering this and encouraging higher-level learning.

Use of Digital Media in Education during COVID-19. During the COVID-19 lockdowns schools across the world were forced to move to distance learning, transforming the teaching style from legacy, in-person teaching to digital, online learning practically overnight in the first quarter of 2020. This sudden and unexpected shift towards digital approaches in education brought about a multitude of challenges for teaching staff as well as students and parents who had to adapt to the technical requirement of virtual classrooms. With that, the discrepancy between households and individual students from different social backgrounds widened regarding conditions of confinement as well as access to equipment and secure internet connection, leaving many students disadvantaged compared to their peers [26, 27]. This shift highlights the pressing need for future educational programs to include teacher's training for producing online educational materials, and for online teaching styles that are more accessible.

IDN usage in digital education has the potential to bridge the digital gap to a certain extent, as they do not require specific, powerful devices or strong internet connectivity and allow students to experience them in their own time, thereby minimizing potential problems that occur when students share devices with other members of their household. IDNs created in software like Twine can even be consumed on mobile devices, making them accessible to a wider range of students whilst offering educators novel and powerful teaching tools.

The challenges of digital media in education are not limited to technological issues. For instance, teachers indicate that the presence of parents in the background has been a disturbance in the educational process and sometimes students felt disconnected from an online class discussion compared to their performance during in-person classes[3]. Furthermore, a research study in developing countries such as Palestine, Afghanistan, and Libya, demonstrates that unclear and limited concepts of digital inequity and digital ethics negatively impact students' engagement in online classes. Thus, education authorities need to develop a clear vision about digital privacy and accessibility which can alleviate parents' worries while their children access mobile phones for online education [28] but also provide access for all students.

However, even with the promotion of using digital media for teaching, pedagogical approaches are in need of improvements to fully capitalize on the potential of digital learning. To date, more than a third of classrooms are expected to be equipped with digital equipment for daily instruction in China[4]. Since 2010, the Chinese government

[3] https://media.shafaqna.com/news/498301/

[4] https://ncee.org/country/shanghai-china/

has piloted electronic school bags (e-SchoolBag) for educational tasks [13]. Initially, the e-SchoolBag plan was just the digitalization of textbooks. It has turned out to have more functionalities with the development of the "learning store" (similar to the App Store) [29]. However, teachers in China are critical to this new initiative as they normally evaluate students based on their traditional academic performance (scores) and prefer traditional teaching methods. The design of an IDN-based application could help students improve their grades in certain areas (e.g., academic writing) while providing instant feedback to assist both students and teachers in achieving their aims.

IDNs and Resultant Innovative Teaching Methods. Studies have shown how an innovative teaching object (namely an IDN) encourages and leads to innovative teaching methods. For instance, Brunel, Acerra and Lacelle [30] have recently conducted an exploratory study which describes how four French and Quebec high-school teachers have explored new teaching practices, by discovering and teaching an IDN (Florence, Annapurna 2018), which was a new object for them. The authors of the study looked at whether teaching a digital work can lead to the development of IDN literacy skills. The results showed that after studying the work "*the students developed specific skills, such as the ability to justify their choices of text animations in a production context or to identify possible gestures and actions depending on the technological environments*" (our translation).

Moreover, the study analyzed how the teachers considered the specific features of the digital work in their didactic sequences and how their choices have also led to evolutions, intended as innovations and recompositions, in their didactic plans and pedagogical implementations: "the approach to this innovative object has led to innovations: new teaching methods have been envisaged, more open to intermediality, subjectivity and reflexivity" (our translation).

Another project that took advantage of IDNs and introduced them into the K-12 classroom was the You&CO2 project which used the lesson-in-a-box concept to teach about climate change [31]. Lessons-in-a-box are a pre-designed set of lesson plans, activities, assessments, and rubrics according to a region's established curriculum framework that teachers can easily make use of in their classroom. Thus, even teachers with minimal technological training and environments resistant to "pilot projects" were able to implement it in their classrooms.

Artificial Intelligence and IDNs in Education. Artificial Intelligence (AI) has gained widespread popularity as a prominent digital technology in recent years [32]. However, it is currently seen as more of a hindrance to teaching, rather than an asset, as teachers cite issues with accuracy and plagiarism through the use of intelligent agents like ChatGPT [33]. However, we argue that this technology has the ability to assist in the mainstream integration of IDNs in the classroom. A significant issue regarding IDNs, specifically the creation of IDNs, is the time it takes to build an IDN system. Since IDNs involve interaction, system builders [34] are tasked with creating enough content for a user to explore multiple different perspectives/stories within a single system. Teachers notoriously cite time as a reason for not using digital technologies in the classroom [35]. While educators consider interactive digital storytelling as advantageous since it provides meaningful learning and is fun and motivational, a major disadvantage is that it is time-consuming and requires technological knowledge [36]. Therefore, the "time"

it may take for a teacher or student to create an IDN system can provide a potential roadblock to integrating this technology in the classroom.

By using AI in IDNs, it is possible to cut back on the time-consuming IDN creation process. Specifically, AI can help generate dynamic and adaptive narratives based on user interactions, simulate intelligent and believable character behavior, generate and populate game worlds, levels, and narrative elements procedurally, and provide intelligent tutoring and feedback. Further research is required in this domain, highlighting the importance of interdisciplinary collaboration among researchers, authors, and software developers. This collaboration should prioritize user-centered design, incorporating user participation, and offering expressive tools that empower authors to craft impactful narrative experiences [37].

The incorporation of AI in education can have both reductionist and holistic effects, depending on how students and educators integrate these tools into the learning process. It is crucial to recognize this distinction, as an excessive reliance on generative AI may impede the development of critical thinking, analytical reasoning, and problem-solving skills [38]. However, the integration of AI in IDNs holds promise for addressing complex challenges and positively transforming education.

Finally, we need to be aware of the ethical aspects of the use of AI in IDN creation and thus adhere to and engage in the further development of ethics standards in the area [39].

3 Examples of IDNs in K-12 Education and Communities

In this section, we look at some projects that serve as proof of concept for the use of IDNs in K-12 education. These projects include communal and tertiary education settings that may be applied to K-12 through adaptation.

The *Mobeybou* materials are among some relevant examples of functioning IDN systems that are being used at school with pre- and primary school children [40]. The materials consist of (i) a tangible digital manipulative (DM) that uses tangible blocks to change digital story elements, (ii) a storyMaker, a fully digital version of the DM (that works without the physical blocks), and (iii) a set of interactive story apps. The materials are designed to work together and complement each other. Whereas the DM and the storyMaker are authoring tools, the apps provide information about the different elements represented in the authoring tools, feeding children's curiosity and narrative creation. Presently, the DM is composed of a total of 60 blocks (however this number can be easily extended) that represent eight cultures from around the world (Germany, Portugal, Turkey, Brazil, China, Cape Verde, and Angola). Each block represents a story element and has the respective visual representation on the upper face (see Fig. 1, left). Each cultural set is composed of seven elements, - a landscape, a girl and a boy protagonist, an animal, an antagonist, a musical instrument, and a magical object - that are representative of the depicted culture. There are also five blocks that trigger different atmospheric conditions (rain, snow, wind, thunder, and night), as well as music, sounds of the instruments and the characters (laughing, humming, yelling, shivering), and ambient sounds.

The blocks communicate with a computer or tablet via Bluetooth, and with each other through magnets embedded on the sides of each block (Fig. 1 left). Connecting the blocks to each other triggers its digital representation on a device screen. Each element has specific animations that display different actions, and animated narratives unfold according to the combination of blocks that the users connect to each other. The interactions between the narrative elements are defined based on Propps' structure of traditional Russian fairy tales [2]. The story world is modeled using behavior trees, such that different combinations of blocks result in the creation of a myriad of original narratives.

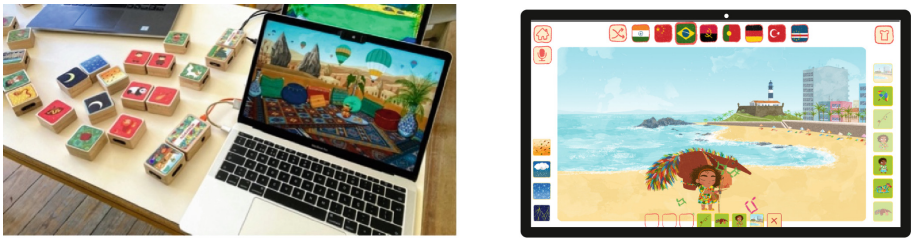

Fig. 1. The digital manipulative (left), and the storyMaker (right).

Children can change the scenario, mix, and remix all the elements across cultures, try out different plots, shift direction and start all over again. As the system provides visual and aural feedback in the form of sounds from the characters and music from the instruments, every child can imagine, and create their own spoken narratives, irrespective of their culture or language. A recording button allows recording/playing children's verbal narratives. The storyMaker is a digital version of the DM, and was developed to overcome the need of having the physical digital manipulative, this way boosting access to the tool.

Although related to the authoring tools, the interactive story apps can be used autonomously, offering themselves as full animated narrative experiences for children's meaning making. Each app presents a geographical map that locates the story in the world map, a 360º environment that incentivizes the children to move their device around to explore and visualize the full environment, a puzzle, a small game related to the cultural elements, an augmented reality (AR) page that offers children the possibility to print their own AR markers and bring the protagonists to life in their environment, and an incorporated glossary with keywords from the story and detailed information about the represented culture. The apps also help to provide context to the visual universe of the stories, informing the children about the country and feeding their imagination and promoting the construction of intercultural stories. The tools have been successfully used at school with primary school children (see Fig. 2).

Beyond attempts targeted at K-12 education, some pilot projects that aim to use IDN for educational purposes have been created in universities such as The *Gaming for Peace* project[5] which works towards conflict prevention and peace building. By role-playing

[5] https://gap-project.eu/

Fig. 2. Children using one of the apps (a) at school with the *Mobeybou* materials using a projection (b).

and making choices in a narrative-focused game, players are able to understand the challenges of a particular societal context, e.g., in terms of cultural norms and gender roles. As a result, people can gain soft-skills (e.g., gender awareness [7]) when working in environments other than the ones they grew up in. Another example could be the *Digital Humanities* + initiative [8], where media practitioners, researchers, local residences and audiences, as the online community for digital heritage, built an interactive documentary (i-doc). I-docs also have an educational function; through interactive video and gamification, people can participate in the learning of local history, for example by designing the batik (a particular Indonesian piece of clothing) motif. Adapting these ideas to the younger audience of the K-12 stage, some concerns such as ethical issues, customization, and policy adoption, would need to be addressed.

All of the above projects offer the opportunity for analysis in order to generate principles and evaluation techniques for future IDNs at K-12 level.

4 Next Steps for IDN in K-12 Education

Given the potential of IDN for education, and the concrete applications as described in the examples section, as well as existing efforts towards digitization in school systems worldwide, there is a considerable opportunity for IDN in education. In the following section, we sketch out a strategy for installing IDN in K-12 education.

4.1 Objectives

Short-term objectives include a rationale for introducing IDN in Education, identifying the target audience for such an endeavor, and a strategy on how the teaching staff would be involved.

A medium-term objective is to bring IDN literacy into K-12 education by providing early exposure to the notion of Interactive Narratives and fostering literacy in the education system. Currently there exists some work with pre-school children but then there is a big gap of no exposure until undergraduate and postgraduate levels. It is understood

that prior to starting the teaching of pupils, their teachers need to be taught and trained on the matter, possibly through an IDN on how to use IDN in education.

A long-term objective is to develop a full Degree program in Interactive Narratives. Such programs need not be entirely supported by any one university but may also be a collaboration between institutions, such as falling under the EU Erasmus Mundus[6] program for joint master's programmes, for example, as well as international exchange programs.

4.2 Short-term Objectives

We start the conversation with a few points that address the short-term objectives and help situate, justify, and parametrize the committee's endeavor.

Rationale. A rationale needs to be built that caters to our target audience. It can be used to present our ideas to the policymakers and lay down the principles of Interactive Education to address educators (both teachers and parents). Presenting the transformative value of IDN for teaching and learning would go a long way in justifying its take-up in the K-12 curriculum, and this can be put into practice through activities that help us understand the dynamics of teaching and learning.

A driving motivation is the need for new narratives that represent the complexity of today's times. The Eurocentric universal story-arc is limited in its representational capacity and a new form of narrative is needed that affords dynamic mapping between cause and effect. This motivates the use of the IDN process for complex learning and thinking, allowing for playfulness, for discovery and for multiplicity in perspectives.

Different forms of storytelling need to be distinguished from the overused narrative structure so popular in films and should instead look at children's play-acting and how they negotiate around improvisations as contribution to child development [15]. IDNs can thus serve as scaffolding for constructivist learning teaching techniques wherein a pseudo-story can start off the lesson with initial content and then provide the students the opportunity to add content - both in class and outside school hours on an online community platform such as Discord, say.

While the introduction of IDN in K-12 education prepares the next generations to be conversant with such a medium, IDNs are also relevant to contemporary complex issues that merit multiperspectivity such as the capitalist construction industry vs environmental activists attempting to safeguard green areas and cultural heritage.

Target Audience. Identifying our target audience will help us articulate what we need as a convincing argument. Candidate members of our target audience are the policy makers and their advisory boards, if a top-down approach is to be taken, and teachers (existing and in-training, who might be more likely to carry the work forward) in case of a bottom-up approach. This may be possible with educational institutions that are flexible enough to allow teachers to perform pilot projects with students, who are the net recipients of this endeavor. Consequently, the third target audience will be their parents, especially in cultures where they are well involved in their children's educational development.

[6] https://erasmus-plus.ec.europa.eu/opportunities/opportunities-for-individuals/students/erasmus-mundus-joint-masters-scholarships

One must also consider the social dimension and seek target audiences that can benefit from having future generations educated in IDN literacy. These include situations where having multiple perspectives helps oppressive situations and their results to be better understood, such as the motivation of Somali pirates in *The Last Hijack Interactive* [16] and topics that are related to global warming such as responsible development in *Fort McMoney* [17]. Reframing the past is also a task in which IDNs can help today's generations re-interpret established history by looking at it from multiple perspectives.

4.3 Medium-term Objectives

Possible approaches that could facilitate the integration of IDN into the official school curriculum could be facilitated through the Official National Reading Initiatives (Reading Lists for schools), which are common in some countries. This is a strategy that the authors of the *Mobeybou* materials (the first example mentioned in Sect. 2 above) are pursuing, as the materials also include a series of dedicated story apps for children. Their strategy consists of contacting the responsible official authorities to include the story apps in the official Reading list for schools. Integration in the list provides an 'official quality stamp' promoting their use and integration in schools as well as their adaptation by informed and engaged parents. This then opens the door to using the other *Mobeybou* materials for IDN such as the digital manipulative and the *StoryMaker* since they dialogue and complement each other. Such could be a possible way to contribute to the integration of IDN in the school curriculum.

It would be presumptuous to think that IDNs can be applied to any topic in any subject, and thus one needs to explore how to go about applying IDNs into K-12 education. Which subjects, which lessons can best take advantage of IDNs? What changes are needed for existing lesson plans to integrate IDNs? What is the return on investment for the teacher's efforts? The better these questions will be answered the more people may become engaged with this approach and make it easier to adopt.

IDNs are a storytelling tool for multi-perspectivity and narrative complexity. They can therefore be conveniently used for subjects such as political studies, religious education, ethics, history, geography, and economics. These subjects in particular have the potential to benefit greatly from multilinear educational narratives, which consider different belief systems, ideologies, and points of view and would consequently allow for more diverse opinions that can generate engaging in-class discussions. Furthermore, by offering a multilinear teaching approach for commonly argued topics, teaching materials can become more inclusive. For instance, world history is likely to be taught through a Eurocentric lens in Western schools, however this approach cannot capture the complexity of the topics [18, 19]. This was for instance observed during an experiment in history classes in Norwegian schools where the result was that non-European history was often taught only in the context of European imperialism and colonialism [20]. Offering alternative narratives in teaching would allow topics to be dissected through multiple different critical lenses and thereby allow for other viewpoints to be amplified in the classroom. IDNs therefore have the potential to offer a device towards the inclusion of students of marginalized backgrounds, as their voices, heritage, and beliefs would be given more space within the curriculum and align with efforts in decolonization [41].

4.4 Long-term Objectives

The way forward is long and challenging but at the start of this endeavor it is important to identify routes that will help make IDNs a viable educational tool. These include reaching out to the educational research community as well as seeking collaborations and sponsorships from the technology industry to assist in dissemination.

Interdisciplinarity. The closure of schools to contain the COVID-19 pandemic in 2020 and in certain regions also in 2021 has forced the learning science community to focus their attention on the role of digital media in online learning [21–23]. Some drew their inspiration from the ICAP framework for designing learners' engagement with activities which lists interactivity as the most engaging mode of overt engagement behavior [24] while others took inspiration from the use of Narrative-centered learning environments in constructivist learning [25]. Such work lays the foundation for future attempts at reaching out to the learning science community, but their evidence-based approach suggests the need for increased efforts in empirical studies before attempting to approach that academic field.

Dissemination. In an ideal world there would be a roadmap in educational systems [42], which demonstrates what can be done in order to provide digital infrastructures for schools to harness the potential of digital media and IDN. This can be facilitated with the help of technology corporations to bridge the current digital gap across the world, because so far governments and educational systems seem unable to reach this goal by themselves. Furthermore, as mentioned, there is a need for trained technical staff to produce digital content and to aid progress in IDN related materials for schools, helping other teachers and employees to learn faster and to reach a better solution while facing challenges. As shortages in schools' budgets, which lead schools to neglect the need for services including consultation services, basic facilities for classrooms, food packages for students from disadvantaged backgrounds and so forth, make these goals difficult to tackle, the proposal of assistance from technology corporations in this matter would make it easier and more achievable**.**

5 Conclusion

Using IDNs to teach complex or multi-perspective subjects in K-12 education would provide a more holistic understanding of the topics, as well as provide future generations with the skills to handle and understand complex issues that abound in the modern society. Other important areas of application exist, for example in terms of fostering prosocial behavior and emotional intelligence in difficult situations. In order for this to happen, teachers need to be trained in IDN authoring skills to develop such IDNs for their topics. Extending these IDN authoring skills to the students themselves will raise a generation who can express their multiple perspective stories fluently to an audience who themselves will have developed their own IDN skills to understand them, resulting in IDN literacy. This is the challenge that this committee is taking up. Inspired by existing proof-of-concept IDN projects with younger audiences, scaffolding upon constructivist pedagogical approaches, heartened by the agile up-take of technology by teachers and students alike during the shift to online learning due to the COVID-19 pandemic and driven by its members' motivation, we look forward to sharing developments with the ICIDS community in the long, medium and, hopefully, short-term future.

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