

EXPLORING ECOSYSTEM APPROACH FOR GAMES DEVELOPMENT AND CONNECTED LEARNING

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ABSTRACT

Strong pathways of connected learning are possible when one makes sense of the complex game development process in the wake of greater interconnected social media tools. This paper reviews and categorizes the core approaches to understand game development processes and proposes exploring an ecosystem-based approach to take advantage of the rising interconnected social media tools. This approach serves to enrich information gathering experiences and intuitively offers greater opportunities for building a firm foundation and understanding of game development.

KEYWORDS

Connected Learning, Ecosystem, Games Development, Framework, Networked Systems

1. INTRODUCTION

Games can be viewed with the “socio-technical interaction network” [1] metaphor and as such have many different consequences. Some of these are social; technological (enablers and innovative) and cultural. They can be positive or negative consequences for example, negative social consequences such as internet addiction [2] and cultural consequences where “...games can not only teach language skills, they can instil and propagate cultural knowledge, sensitivity and awareness...” [3]. Getting games and games development right have never been in greater demands. Meanwhile, with modern games development tools, games are becoming more complex in terms of graphics, gameplay, interactivity and narrative while at the same time, games are exposed to more users and players, in short, a wider audience.

As socio-technical systems, consequences from these games evolve depending on the path taken. An unguided evolutionary growth will suggest that we may end up with more negative than positive consequences that will eventually reduce the benefits of play. Research under the category of game-based learning attempts to draw linkages and as mentioned by [4], looking at the 3 categories of arguments for digital game-based learning, it was suggested that in order for games to support learning, conditions and constraints needs to be fully spelled out. Similarly, we take cue from [4] and consider the needs to spell out conditions and constraints that help nurture a guided evolution particularly via the game development

processes.

Games development is a creative, passionate and purposeful process and connected learning is about having passionate users creating opportunities for others [5]. Synergies between these two domains benefit the field. However, it is not the intention to delve into a full discussion of games and learning as it is beyond the scope of this article. This research has a narrower focus, aims to fill the gap and establish the link between games development and connected learning. In addition, this paper departs from a focus of looking at aspects of involvement. Involvement is often suggested as the primary link between games and learning [6 - 8]. While there is an earlier study [9] addressed the law of learning for Games where they include motivation, feedback, practice, positive feelings and intensity, there is a need to further investigate the linkages especially between games development and connected learning. We propose that given the modern games development scene, in addition to involvement, an ecosystem approach serves as another bridge between games development and connected learning. We further propose the use of D-framework to help shed light on the linkage. This framework is developed based several interrelated efforts; first, on informal questions with students who undertook formal learning of games development; second, on reflections of students' inputs and a synthesis of the progress of game development tools; third, discussion with selected industry representatives. The contribution of this paper is to add to the scholarship on games development and for users to see how and where the links are forged.

This paper is organized as follows: First, we explain selected key concepts and identify their relevance; next we discuss the D-framework, looking at selected foci and components that frame the linkage; we apply this framework and provide a link to the results. We discuss our framework in terms of these applications and highlights the limitations and benefits of connected learning.

2. PRELIMINARIES: SELECTED KEY TERMS

We look at selected key terms that will help pave the way for the presentation of the D-Framework.

Games Development Tools

Modern games are increasingly complex, hence, games development literacy has taken new dimensions and meaning. Game developers now must be well versed with visual modelling tools and code programming. While it is no mystery that games are gaining important impact in many aspects of our modern living, it is also true that game players do not immediately become developers. A number of other motivations are needed, one of which is the competency with modern game development tools. Over the years, the games development scene has witness a tremendous growth of tools ranging from 3D modelling and animation to game frameworks and game engines. These tools share a number of common features such as complex, large software applications; third party plug-in; scripting and programming support. Amongst the top development tools are Unity, Unreal Engine, Havok® [10 - 13] and Autodesk® Maya [14]. These tools play a vital role in enhancing interests, especially in the fields of simulation sciences and games development.

Simulation and games have overlapping traits in that the rules are programmed into the codes. As such, an important aspect is the synergy gained from simulation and games development. Simulation and games development clearly have many lessons that can be gained from each other. On the one hand, simulation being an 'older' field will benefit from the 'newer' technologies and techniques especially in the area of creative art, visual modelling and representation; on the other hand, games development clearly can benefit from the broad theoretical foundations of simulation sciences. As in all new and modern technologies, more game development tools will benefit but do not guarantee more games development.

Ecosystem

The term ecosystem has its root in ecology and most likely coined by ecologist, Sir Arthur George Tansley, 1871–1955, to mean a system comprising “climate, soil and organisms”[15]. A more recent definition is given as “...An ecosystem is a loosely coupled, domain clustered environment inhabited by species, each proactive and responsive regarding its own benefit while conserving the environment...” [16]. Since then, the term has been cross applied to various other fields to imply interrelated elements or connected network of elements [17 – 20]. In many cases, non-ecological ecosystems are usually seen as counterpart to the original ecosystem metaphor and are similarly viewed as connected and self-organizing. An ecosystem-based paradigm carries with it the two implications: one that is self-organizing and the other that is a nature- inspired mode of organizing and solving complex resource management issues.

The strength of an ecosystem-based paradigm lies in its power to connect the multifaceted dimensions of information, ranging from the technical, to the social and cultural domains. This system in interconnectivity allows for a rich interplay of the different impacts of information and by facilitating and establishing pathways of connectivity, intuitively, opportunities for stronger learning arises.

Why is this paradigm important? Games development tools' websites are starting to provide connected information, in the form of an ecosystem of learning materials. In many ways, with an established ecosystem of learning nodes, one is able to gain access to many other related learning nodes. Each node can be a video tutorial, a link to community of practitioners; or simply another node at another level. This multi levels, multi-linked channels extend the range and exposure available. This is the same benefit one can get from hyperlinked information of the World Wide Web and perhaps “WWW” can now refer to a different paradigm of “Wide Web of Webs” [21].

In addition, the ecosystem paradigm is also observed in the other social, technical and community-based dimensions of systems. In all these systems, the ecosystem or networked elements surface as key linkage that forms the bridge between individual and groups. In the social dimension, there are social networks, in the technical field, there are networked infrastructures and in the global communities, there are communities of practitioners. These different dimensions also are interlinked, giving effects that can co-evolve and changes over time or over different groups of users. While these observations are not new, what it does allude to is that of more complex interactions and implications for learning and games development.

This ecosystem paradigm forms the central pillar of the D-framework and the rest of the other components support this main conception. The ecosystem approach offers a novel way to experiment and organize essential learning and understanding of games development and it is also this approach that facilitates connected learning.

Connected Learning

Connected learning has several different meanings. Early usage of this concept suggest some form of linked learning outside of classroom, and possibly through some form of social interaction, a kind of “extra” steps necessary for learning, that of “connected knowing” [22]. Another meaning of connected learning suggest that learning can be achieved in stages as in related discovery or adaptive learning [23]. A variant of these concepts can be viewed from reinforcement learning theory, where the agent is connected to the environment and achieved its goal through learning of other teammates’ experiences[24]. Finally, connected learning can also carry with it a wider implication, that of creating and helping others; creating a pathway of opportunities and engaging in a journey of learning[5]. Such a meaning suggests that connected learning is valuable for learning organizations and perhaps a platform to generate social capitals for the global communities [25]. As suggested by [26], “...learning is an active process in which people construct new understandings of the world around them through active exploration, experimentation, discussion, and reflection. In short: people don’t get ideas; they make them...”

Given the many different flavours of connected learning, this paper looks how the D-framework is able to facilitate selected aspects and highlights the other aspects that the D-framework does not address as they are best left to other more appropriate tools.

Network Science

The term network science refers to the use of network tools to do science [23 – 27]. This idea started with network scientists and has since move on to many other fields. It is not only for scientist; but extends to artists, technologists, policy makers, just about anyone with a connection to the Internet. Indeed, network tools are more than a tool and instead, they are ubiquitous and play an important role in modern day-to-day social interactions. In many communities, network tools are used for tasks such as order taking, warehouse stock taking, notation, music recording and just about any tasks involving form filling and notes taking. The use of network tools, especially tablets with wireless connectivity has given added dimension to mobility and mobile applications. Learning tasks and resources has also ventured into the mobile domain and this new dimension is expanding. Students are now viewing notes, information via smart phones and tablets; in many places, coordinating appointments for health screens and medical tests can be done via mobile applications; likewise, smart phone banking is common mobile task that is recently available and becoming indispensable. With mobile subscriptions nearly equal to world population [29], there are strong potential for a quiet mobile revolution to take place and to transform the way we live and learn. This new mobile dimension is an important aspect not to be taken lightly and not to be dismissed as another trivial technological trend.

Implications and Synthesis

One of the core implications is that new tools, new technologies and new platforms are influencing games development. We view games development as an evolving process and as such, needs to take into consideration the changing technologies; ecosystem and network effects and the availability of many channels of information. This suggests that there are greater opportunities to learn about games development through the newer digital channels and that learning is no longer limited to a sequential process or information flow. With the new digital interconnected channels, learning is more likely to take place in a less sequential way and allowing for information sharing that are likely to be conducted in parallel. In order to have a clear understanding of learning in the digital age, we next review some of the various learning approaches.

3. REVIEWS OF APPROACHES

With new digital environment and space, there are more avenues for learning and more things to learn. Learning in the digital connected age is both a combination of traditional learning ways and include also learning with the new digital tools and channels. As we encounter newer digital platforms and tools and as we advance in the ways we carry out our digital lives, we are also faced with more channels of learning that are non-sequential and multi-modal. In fact, the central idea of connectivism [30-31] resolves around the concepts of how new digital technologies (such as the Internet) creates opportunities and facilitates learning. Here we begin with reviews of selected learning measures.

Overview of Learning Methods

Learning has traditionally been viewed as a process where outward manifestation of new behaviours signifies or proves that learning has taken place. As a behavioural approach, this process relies heavily on outward display and related measures. The other form of learning comes from a social learning approach as opposed to a behavioural approach. While the behavioural approach is more individualistic, the social learning approach suggests a more interactive and group or peer influence focus. In recent digital development, we also see online learning, learning that are facilitated by online technologies and supported by virtual peers and communities of experts. Closely related to these learning are ideas of episode learning, learners' profiles, learning environment and technologies. In the next few sections, we provide brief overview of these learning approaches.

Non-Digital Learning

The field of learning and learning theories is a big and complex domain and have seen contributions from many researchers and experts. Hence, it is not possible to do justice to try to cover non-digital learning theories in a few short sections. Here, we provide a brief overview and core ideas.

In this grouping, we have all the traditional learning theories, theory that comes from psychology, such as motivations, needs, traits and conditioning as well as sociology, education and human learning. We have left out those areas of digital media, technologies and online features for

purposes of this article. We group those areas under a new section of “Digital Learning Theories” (see next section). This separation is not cast in stone and is done for ease of reading. As we can see, the theories grouped under non-digital section are well covered theories and they attempt to explain how as an individual and how as we go through different stages of growth and development, how each individual gains the required knowledge and behaviours. A primary focus was on explaining the accumulation of behaviours needed for sound human to human interactions. Over the years, focus also advanced (going from individual to social to asocial), moving from individuals to groups and peer-based communities, we have learning theories that are based on learning environment and based on ideas of imitative learning, self-regulation and visualization and self-efficacy. These concepts reinforce individual conditioning and explain other aspects of social norms and cultural behaviours.

Digital Learning

Digital learning explains how learn can take place in the newer digital sphere that humans are living in. These digital sphere forms many pockets of interrelated digital ecosystems and these environments play a significant role in shaping human learning and understanding. Some of the newer digital technologies to enable learning are: interest-based communities; Seek and Search platforms (like Quora.com), and many massively open online courses (MOOC). One common aspect is the reference to and applicability of network science and connected relationships. Here we believe that it is useful to include both aspects of digital learning: firstly, those learning that rely on digital environment, platforms and technologies and secondly, those that use new digital and network science concepts to advance learning, for example, deep learning [32] and brain connectome [33].

While behaviourism, cognitivism and constructivism are well known learning paradigms, alternative views of learning include: pragmatism, social situated learning and computer-supported collaborative learning. One of the newer theories are networked learning where knowledge is gained through mediated community and community of learners [34].

As in most learning, associative learning plays an important role, the same is somewhat discounted in digital learning, where the opportunity for associative learning may be reduced in online environments. Many online communities and online learning tools address such reduced association with more phatic-like technologies, graphics and visual cues.

Learning and Games Development

As seen from the myriad learning paradigms, the new digital age suggests we need more understanding and this is best achieved via a simple and comprehensive digital learning framework especially for learning games development. Learning is no longer a single episode; it is no longer an isolated activity that is undertaken to advance core interests. Learning in our connected age will depend on a few critical assumptions, namely learners have foundational digital information seeking skills and have sufficient easy access to the information conduit. With these assumptions, we formulate our D-framework to ensure us to view learning, and especially learning for modern games development.

4. D-FRAMEWORK

The D-framework addresses two interconnected concepts of dimension and design. These components of the D-framework were formulated from a digital learning perspective and facilitate new learners to better understand games development concepts. They help guide and shape learning given the new digital development tools and platforms. Here, we cover these three core components:

Dimension

The dimension component refers to the 3 common elements of environment, contents and communities. Certain selected observations of this component are:

- Games development is a complex discipline that involves application of various fields such as computer science, software application development, mathematics, physics, artificial intelligence, creative designs and others. Each field comprises many concepts, theories and techniques. In order to effectively cross-apply these domains, linkages in learning are needed, hence, the idea of connected learning. Connected learning is a desired outcome of all training and they share common overlaps, for example, development and connected learning heavily rely on having appropriate environments; suitable contents and well organized communities. The importance of these elements with respect to connected learning and games development is bi-directional. Games development as well as connected learning requires these elements to be addressed.
- One perspective of the three elements is that of an interconnected gear system. Each gear element is linked. For example, environment, contents and communities are inter-linked, where each element depends on the other. Environment is influenced by contents and contents are derived from communities. Communities in turn cannot ignore the effects of environment.
- Another perspective of the three elements is the idea of “orthogonality”; an orthogonal perspective is one of independence. The idea of independence is from a learning process, that is, learning in each of the element domain can be done independently. A learner can be learning about the environment, the contents as well as the impact of communities.

Design

Design is a non-trivial task and takes on centre stage in games development. This component addresses the important design feature and covers important domains such as game design, levels design, HUD design, and interactions. A central idea of design is the need to ensure that design provides the required user experiences and that the learning elements include a design focus. Design component is guided with the following aspects:

- **Planning.** Planning and design is no longer a solo activity and design efforts for the new digital age must be supported by a group of community and receive feedback from experts and users. Just like innovation and new creative tasks, fellow peers and exchange of ideas feed on each other and help to promote and improve on the flow of ideas development. Design, especially design for the new information devices (such as wearables, digital gadgets and sensors) are not only aesthetically pleasing, balanced,

functionally useful and digitally connected.

- **Computational Thinking.** An important area not to be overlooked is the need to apply computational thinking to design efforts. Just like learning, designing is closely link to another critical thinking activity, that of computational thinking. Computational thinking as suggested by [35] is the critical process enabling correct problem thinking, leading to the problem formulation. Like innovation, computational thinking will be the basis for “creative destruction” for design creativity [36]. Here, we include the suggestion of [37] to apply the important paradigm of space of “concept” and space of “knowledge” for design reasoning. An important element of modern design will be the socio cultural dimension, that is, the social setting will be equally important for design as well as for games development.

Device

The device or platform component focus on the issue of deployment and straddle cross platform issues. Understanding modern games development require careful consideration of device and implementation. The recent advances in bioelectronics, communications and computing has given rise to new ways of digital connections such as digital wearables and gadgets and new ways of digital engagement. The device component is helpful to guide game developers understand the important platform consideration. Some critical considerations include (a) how fast and how soon is the data needed from the device; (b) latency and (c) selection issues of cross platforms.

5. APPLICATION AND DISCUSSIONS

We apply this D-framework to the teaching of games development course. Based on the D-framework, we derive a video games curriculum document to guide learners and educators alike. In [38], we have presented our initial work and demonstrated the results. In this article, we include selected observations on some of the lessons gained from the use of this D-framework and the video games curriculum guide.

Dynamic Information Grid

The video games curriculum guide is useful at the planning stage and during the learning and development process gathered information tend to change dynamically. The ways to address the dynamically changing information can vary and depends on either it is a minor change of information (such as a minor version change in software tool upgrade), or it is a major change of software version. The larger the change, the more challenging it is for learners to handle and care must be ensured to avoid having to “un-learn” and to “re-learn”.

Guide is Not Delivery

The video games curriculum guide does not guarantee information delivery and sustainable learning. The plan is after all a guide and a new learner has to distinguish between the different delivery modes. With the new ecosystem of information, there are new mode of deliveries, such as traditional method of static delivery versus interactive audio video display. While the guide is useful to help select contents for learning, it still necessary that new learners ensure suitable learning context; environment and seeking inputs when needed.

Guide is Not F1

The video games curriculum guide does not provide interactive help and/or does not provide clarifications when a new learner need one. In short, it is not the “F1” key where a new learner can press to seek for immediate help. This is a meta-level guide and learners need to learn how to manage the meta information and to learn also new ways of seeking help and answers based on the new digital environment.

6. CONCLUDING REMARKS AND FUTURE WORK

Future research will address more complex pathways of connected learning and compare various different modes of content delivery based on the D-framework, in particular, we will compare traditional modes versus new modes of social media sharing of information. Another branch of research will examine the value of nature-inspired computational thinking approach for a game-oriented view of connected learning.

Games-oriented view of connected learning like that of network science is gaining importance as problem solving and computational tools. In order to be able to promote such “game-oriented” view for organizations, business and the next generation work force, we need to blend in with the new digital era and information flow. The D-framework helps to guide new learners in the way of games development. Careful application of the D-framework will be useful to navigate the new ecosystem of digital information and allow for connected learning in the new digital era.

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