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Kinder Learns: An Educational Visual Novel Game as Knowledge Enhancement Tool for Early Childhood Education

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Abstract: Because of its potent force within the educational settings, digital game-based learning is considered as a methodological means to keep up with the changing pedagogical landscape precipitated by technological developments. While educational technology has already established its presence in most parts of the education sector, it is still under-used in kindergarten level. The purpose of this study is to develop a digital educational game called "Kinder Learns" by using visual novels as the game design and K to 12 Kindergarten Curriculum Guide of the Department of Education as the game content, and to investigate its impact as an educational tool for preschoolers and educators. A digital educational game development methodology was employed to sensibly plan, design, develop, and implement Kinder Learns. The game impact was then evaluated by 243 preschoolers and 29 preschool teachers from the Pasay Schools Division of the Department of Education using the Serious Game framework, which is composed of learning and pedagogy theory in combination with gaming requirements. The result supports the acceptance of the game as an educational tool for knowledge enhancement in preschool. Kinder Learns shaped a novel realization that technology has a place in the early education landscape. Consequently, the game has successfully reinforced the positive influence of employing a digital educational game into the classroom curricula of preschool education and the unequivocal stakeholders' perceptions towards technology use in early education years.

Keywords: Digital Educational Game, Visual Novel, Digital Game-Based Learning, K-12 Basic Education, Kindergarten, Early Childhood Education

Introduction

Inside a digital society, indigenous games are highly regarded as foundational, yet also considered to be an obsolete element of human culture in juxtaposition to electronic games, which are deliberated as cultural and media vanguards in today's fast-paced world. In the last decade, digital games have vigorously assumed sovereignty in the education sector. As pointed out by Gee (2005), games and learning engage humans at a deep level of pleasure. Perhaps, these primordial human urges are the reason why educational games are still deeply entrenched in the digital culture. In today's digital environment, educational institutions must comprehend the complexities of incorporating digital games in education in order to survive and cope up in a technologically-biased pedagogical landscape. Thanks to the international research community, the educational use of digital games is not an unexplored research territory anymore. In fact, the body of knowledge is widely distributed over a number of disciplines such as educational studies, information technology, psychology, instructional technology, business studies, literary studies, ethnography, sociology, and history. Discounting the discipline to which an educational game was created for, there are theoretical foundations, learning design features, and game properties that were recruited as fundamental modalities of the game architecture of this study.

In pursuance of developing the digital game in this paper as an effective as possible knowledge enhancement tool for preschoolers aged three to five, the proponent envisaged how digital educational games should be conceptualized, modeled, designed, and developed through combining theoretical and technical knowledge with empirical experiences found in different studies. Undeniably, the game concept will dictate how much investment a learner will put into playing the game. Learners, when experiencing curiosity especially in the contents of the game, are instinctively inclined to continue playing the game resulting in a completion of more tasks (Malone 1980). However, as contended by Mildner, Stamer, and Effelsberg (2015), there should

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be an emphasis not only on the integration of learning content but also on an engaging design when developing learning games. Moreover, an inviting screen design, where learners can naturally feel they are playing rather than operating a program, can motivate them to engage more. In general, both content (Amr 2012) and design (Haworth and Kamran 2011) are essential features of an educational game that must be put into consideration if the goal is to create an effective educational game. Consequently, the proponent decided to use visual novel as the game design, and a K to 12 Kindergarten Curriculum Guide, as the basis of the game content, both of which will be explained in the next section. Guidelines for creating mobile applications for young children (Mak and Nathan-Roberts 2017) were also put into development consideration to ensure that the proposed educational visual novel game is compliant with childhood developmental factors, such as cognitive (i.e., knowledge, abstract thinking, memory), physical (motor capabilities), and emotional (i.e., engagement, progress learning, reinforcement, feedback).

In this paper, the proponent systematically discussed the development of an educational visual novel game called "Kinder Learns". The main goal of Kinder Learns is to serve as a knowledge enhancement tool in diverse learning areas such as mathematics, language, science, music and arts, physical education, social studies, and values education as outlined in K to 12 Kindergarten Curriculum Guide (Department of Education 2016). As supported by previous researches, cognitive enhancement and social growth for four and five year-old children are encouraged through the developmentally appropriate use of technology in preschool classrooms (Beschorner and Hutchison 2013), and a viable learning context is established for children aged from two to six years old using tablet PCs (Yelland and Gilbert 2011). This is why the very existence of the game is about offering a vehicle to complement traditional teaching strategies as already mastered by preschool teachers, and provide diversity in their teaching methodologies where they can "facilitate explorations of our young learners in an engaging, creative, and child-centered curriculum" (Department of Education 2016). Subsequently, its effectiveness as an educational tool for preschoolers was investigated and evaluated through the assessment of its direct users, (kindergarten teachers and preschoolers) using the Serious Game framework, which includes learning and pedagogy theory in combination with gaming requirements. More specifically, the proponent wants to establish the potential of visual novel as an educational game genre, especially for young students. As little game prototype and research have been done in the development of visual novel game and its effectiveness in education, respectively, this study means to contribute to literature and provide a baseline for educational game developers and researchers who will conduct similar project and research in the future.

Theoretical Background

Early childhood education is undoubtedly a precursor of cognitive, physical, emotional, and social development of young children. It is in this regard why the educational system itself must be improved and revolutionized in such a way that it can actively and efficaciously nurture and help preschoolers to better regulate their learning and knowledge acquisition. Several books and studies of child development experts (Stevens-Smith and Stegelin 2015, Scarlett et al. 2005, Pellegrini, Dupuis, and Smith 2006) strongly recommend play as a critical component that can stimulate several types of learning that encourage a healthy brain development.

Consequently, one may argue that there is no better medium to incorporate learning than play itself. Combining it with the technological needs of the digital society, a digital educational game has surely a place in early childhood education and should be a significant feature of all curricula. Admittedly, the use of technology medium, such as smartphones or tablets, has been an issue that poses several difficulties for children (Batista and Barcelos 2014), and choosing the most appropriate educational apps for them has been indeed problematic for teachers (Papadakis and Kalogiannakis 2017). Recent researches still suggest that a purposeful use of these devices can support and enhance cognitive and social growth (Mak and Nathan-Roberts 2017). In order

to develop an educational game that can be easily adopted in a stimulating learning environment, the proponent used several studies, concepts, and techniques as considerations and foundations of the educational game as will be explained in the next subsection. First, the impact of Information and Communications Technology (ICT) in young children was assessed through existing evidence to make sure that there is no harm in deploying the game. Then, examples of digital game-based learning were analyzed to attain workflow techniques and game features to be incorporated into the game development stage. Lastly, visual novel was examined if it was a suitable, if not the best, genre to deliver learning and knowledge acquisition via digital game to preschoolers.

Impact of ICT in Early Childhood Education

When it comes to ICT integration in early childhood education, the ongoing discussion referring to the ambiguous impact of technology on young children is almost over. What once was a polarized debate between believers and dissenters as to whether technology should be considered and integrated into early childhood education settings has started to become more universally accepted, given the right constraints (Jeong and Kim 2016) and properties (Blackwell et al. 2013). Despite early resistance, the global education sphere has already begun the integration of technology into the classroom curricula rather than utilizing it as an isolated curriculum component. In the case of the Philippine education system, one of the general guiding principles of the National Early Learning Framework (NELF) of the Kindergarten Curriculum Framework (KCF) is supporting the integration of multimedia technologies as well as computer-enhanced activities to encourage diverse learning activities in the implementation of the learning program under the K through 12 Basic Education Curriculum (Department of Education 2016).

With recent findings from a substantial research revealing the positive effects of technology in early childhood education (Burgul and Yağan 2009, Nacher, Garcia-Sanjuan, and Jaen 2016), the success of preschool educators in supporting children's cognitive development through the use of computers in education programs (Bağcı, İlbay, and Bağcı 2014, Lupu and Laurenţiu 2015, Yurt and Cevher-Kalburan 2011), and parents' positive perceptions and attitudes towards the role of technology in their children's early education years (Ihmeideh and Alkhawaldeh 2017), the realization of technology as an ideal mechanism to foster educational activities for preschool children is inevitably expected. Among other things, this gave the proponent the motivation and inspiration to initiate this study. If Kinder Learns is efficaciously developed as advertised, as a knowledge enhancement tool for preschoolers, then it is an addition to the list of evidence proving the positive impact of technology in early childhood education.

The Digital Game-Based Learning Revolution

Over the last few years, several experimental studies have been conducted that led to the intensification of digital game-based learning. Tüzün et al. (2009), Almeida (2012), Alshammari, Ali, and Rosli (2015), and Chen (2017) identified educational computer games as an effective tool that can positively influence the learning motivation and academic performance of students. In a study conducted by Hoffman and Nadelson (2010), it was discovered that learners find video gaming a challenging but relaxing platform that can lead them to better cognition. In addition to improving cognitive abilities, Olson (2010) pointed out that digital educational computer games can serve various needs, such as social, emotional, and intellectual. As investigated by Scanlon, Buckingham, and Burn (2005), educational video games motivate learners in such a way that traditional methodologies cannot which was later supported by Hayes and Silberman (2007). Undoubtedly, the incorporation of video games into classroom instruction to assist traditional classroom learning strategies is not detrimental but actually increases learning and motivation.

To develop Kinder Learns as pedagogically effective as possible, the proponent looked at several educational games and what made them successful. For instance, a computer-based

mathematics game called "Decimal Point" suggested design considerations integral to its success, such as relative simplicity of the game's design, single-player format, uncomplicated game mechanics and straightforward narrative (McLaren et al. 2017). In a digital game called "The MOBO City," thematic feedback was delivered when students made an incorrect choice, which provided them an immersive experience that helped them learn vocabulary (Fotouhi-Ghazvini et al. 2009). The same game design technique was applied in a 2D action puzzle video game called "Trash Attack" (Fernando et al. 2019). On the other hand, Revano et al. (2018) utilized a computer algorithm called Fisher-Yates to shuffle the sequence of riddles in their logical guessing game. The study shaped a realization that an integration of an algorithm from the field of computer science to video game development is indeed worth exploring to strengthen the game mechanics and overall game experience. Lastly, a mobile game about plant science education called "Little Botany" was perceived as a fun and enjoyable learning tool by players because of its primary characteristics such as content, storyboard, rewards, graphics, sound effects, and user experience (Jamonnak and Cheng 2017). All of these successful digital educational games' features and mechanics were considered in the development of Kinder Learns. Characteristics of the aforementioned games were then improved to match the kindergarten setting based from the guidelines of kid-friendly mobile games created by Mak and Nathan-Roberts (2017).

Visual Novel as an Interactive Digital Storytelling

In early childhood, storytelling is a means to reinforce conceptual development. It is one of the oldest forms of education and is still considered appropriate in stimulating and fostering the development of creativity and social skills (Hall 2012), as well as memory and writing skills (Sarıca and Usluel 2016, Speaker, Taylor, and Kamen 2004). Furthermore, Lynch and Simpson (2010) pointed out that storytelling provides academic opportunities for social interaction which involves necessary interpersonal skills, such as empathy and communication. Storytelling, most especially when the audience is children, is a decent teaching technique. Its power in terms of engagement, however, has decreased since the rise of technology, as learners are starting to prefer the use of fancy gadgets like smartphones and tablet PCs. Therefore, transforming this learning technique to match the technologically-biased arena will, if not bring back its truest potential, make it a better version of itself in the education landscape.

If storytelling is to be intentionally combined with both learning and play, a visual novel (ビジュアルノベル bijuaru noberu) is one of the most appropriate game genres. While it was originated in Japan in the early 1990s (Cavallaro 2010), various researchers have started using this anime-style game in their own countries. For instance, Agusalim (2015) from Indonesia developed a visual novel game for English conversation where it was declared "fit" based on their syllabus of conformity assessment as validated by a team of media experts and students. Boston, Yin, Ring, and Bickmore (2012) developed an interactive visual novel to promote patient empowerment through engagement and it was found out that participants with more game experience and those who claim to prefer role-playing games and adventure games tend to better enjoy the game. Moreover, a popular fifteenth-century epic poem known as "Ibong Adarna" in the Philippines was also transformed into a visual novel by Agos Jr. et al. (2013) to compare its reliability, user-friendliness, portability, and accuracy in an existing game. The result revealed that the visual novel game is as good as the existing instructional material used by the institution. This convinced the proponent to use visual novels, an enhanced version of storytelling, as the game genre for delivering lessons to preschoolers and as a knowledge enhancement tool.

Synthesis

Dissimilar to what is recognized in the education sector, recent studies support that technology integration in early childhood education can help in cognitive development of children. With the right game features and a strong game development guideline, the installment of an educational game in the curricula can produce beneficial results rather than bring harm. Lastly, visual novel is a game genre worth exploring, since storytelling is important for children's mental growth. This study, therefore, aimed to develop a game to create an immersive learning environment for kids.

Kinder Learns: An Educational Visual Novel Game

Figure 1: Kinder Learns Game Splash Screen
Source: Garcia 2018

Game Description

Kinder Learns is an interactive visual novel game playable in different platforms and devices designed as a knowledge enhancement tool for preschoolers. It features a series of educational games based from various learning areas such as mathematics, language, science, music and arts, physical education, social studies, and values education as outlined in K to 12 Kindergarten Curriculum Guide. Told through an immersive branching narrative, the game puts the preschool students into the shoes of Zander Blake – an olive-skinned, black-eyed, black-haired preschooler who wears a white long sleeve polo shirt, navy shorts, and carries a red water bottle. When obstacles (in the form of questions) are presented, students make choices that shape the routes of Zander Blake (or themselves). It is the very component of the visual novel game that gives a personalized adventure to make learners more engaged and acquire knowledge.

Game Characteristics

Drawing from literature, the characteristics of a successful educational game, as well as the features that make it interesting and engaging in the eyes of its users, have been considered in the game development. Most of these components have been either changed or improved according to the guidelines created by Mak and Nathan-Roberts (2017) to match the kindergarten setting since some of the studies mentioned in the literature were conducted and tested at other educational stages. The striking screen design is the first thing the learner will notice when the game home screen pops out, as can be seen in Figure 1, and the same goal was applied in all the succeeding game screen designs. Following the advice of Mildner, Stamer, and Effelsberg (2015) in order to put emphasis on an engaging design, a lot of time and effort were exerted to make sure that the screen designs were as inviting as possible to make learners feel that they are playing, rather than operating a program. When it comes to the game content, the main gameplay requires the learners to put themselves in the shoes of the main character boosting curiosity to make them inclined to continue playing the game resulting to a completion of more tasks (Malone 1980). As inquiry-heavy as it may sound, there is still a relative simplicity in the game's design, straightforward narrative, along with simple game mechanics, which are all endorsed game design considerations by McLaren et al. (2017). To cultivate the game to be more entertaining and engaging for learners, the inclusion of media elements such as videos, graphics, and sound effects were guaranteed as per advised by Jamonnak and Cheng (2017) and as proven by Garcia (2019).

Nevertheless, finding the optimal balance between learning and entertainment was still a priority as the proponent acknowledged that not all games are suitable for learning, nor would presenting any learning material in a game-like setting improve the transfer of learning. Therefore, a solution proposed by Ritterfeld and Weber (2006) in incorporating entertainment and learning in digital games was included in this study as well. The solution for bridging the gap between learning and entertainment revolves around three different approaches. The first approach is called "reinforcement paradigm," where the parts of the game that are expected to be entertaining are offered as rewards for successful learning. Another approach, "motivation paradigm," incorporates game elements to evoke interest and capture attention to make the learners ready for the learning procedure. Lastly, "blending paradigm" is about the enjoyment of game mastery that is considered equivalent to the enjoyment of knowledge acquisition. Aside from the thematic feedback that can be seen in the reinforcement paradigm, which is also recommended by (Fotouhi-Ghazvini et al. 2009), the remaining two approaches were also considered and integrated into the development of Kinder Learns instead of choosing just one approach that might be suitable for the game narrative and architecture.

Game Modes

Currently, there are two game modes: adventure and classic. In the adventure mode, students will thoroughly follow the day-to-day life of Zander Blake, both inside and outside the classroom environment. Lessons will be presented in the school and questions per each learning area depending on the topic of the day should be answered. Correct answers will be acknowledged to inspire the students, and wrong answers will be corrected in a fun and encouraging way as suggested by Fotouhi-Ghazvini et al. (2009). After school, Zander Blake will encounter moral dilemmas that will teach students values. In the classic mode, the students can choose the specific learning areas that they want to learn, and though it has its own storyline, it uses the same questions and targets the same objectives from the adventure mode. This is to ensure that both game modes will deliver the same outcomes after playing the game. Unlike the adventure mode that follows Zander Blake's every action, the classic mode will jump from one lesson to another focusing on the learning content rather than the narrative context. In that way, students can have a review in the learning contents without going through the whole story again. In the future, the

proponent envisioned the game as a platform where there are other game modes to cater other learner types such as multiplayer game mode, outdoor quests, school contest mode, leaderboards, new storylines, and more.

Adventure Mode

When a learner chooses the Adventure mode, the story will start from the beginning, where the narrator tells the background story of Zander Blake and his everyday life both with his family and in the school environment. The learner can dictate the flow of storyline and the outcome of each scene as long as it involves decision making which, in this case, is in the form of questions. This is to make sure that the learners will be able to put themselves in the shoes of the main character and become the protagonist in the fictitious world, in addition to boosting their curiosity, which is a precursor of more task completion and enhanced knowledge acquisition.

Extending the idea of narrative within the game, the nonlinear stories with believable and intriguing plotlines and characters were strategically placed to actively engage the learners as these are central to the experience. This is the reason why the adventure mode provides the whole narrative of the story; and, to build up confidence to influence and contribute to the unfolding plot. This component of the game covers as well the marriage of the symbiotic relationship between plot and character all at once. As stated by McGonigal (2011), players who recognize story patterns accustomed to them will be more inclined to assimilate more concepts. Along the way, it is expected for learners to make mistakes and the game architecture encourages it because this is one of the opportunities to reinforce the teaching and learning process. Moreover, mistakes are considered as healthy challenges, rather than crushing defeats.

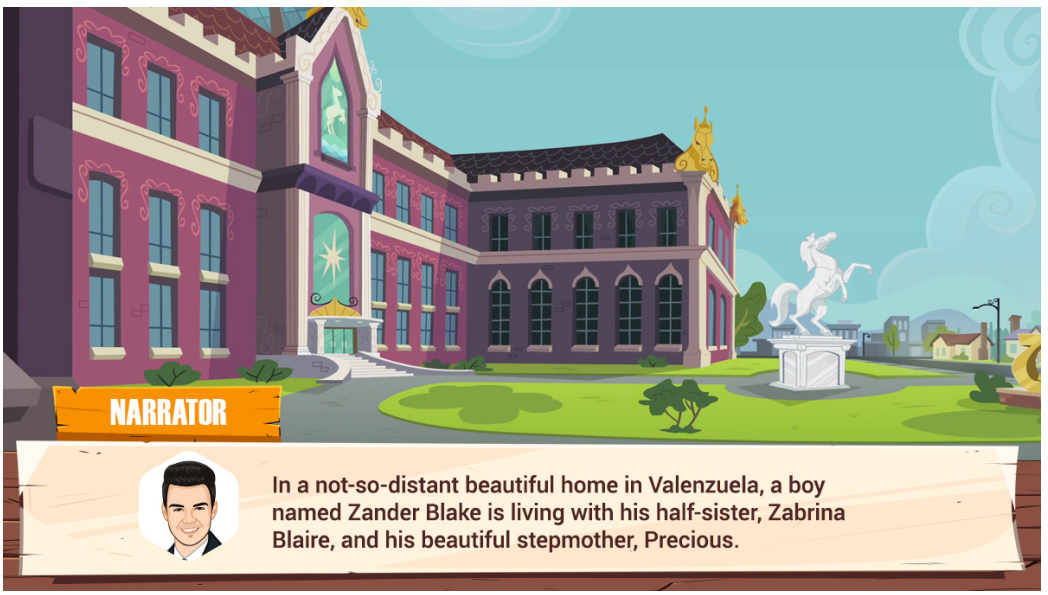

Figure 2: Adventure Mode–Scene 1, The Beginning of the Story
Source: Garcia 2018

Classic Mode

When the learner chooses the classic mode, the list of learning areas as outlined in the K to 12 Curriculum Guide will be presented as a game menu. In here, the learner can choose which subject to learn, and the game will skip parts of the story to focus only on the scenes related to the chosen subject. For instance, if the learner chooses to learn Mathematics, then the visual

novel game will start right away on the subject discussion as can be seen in Figure 3. Even though it has its own storyline and visual route on the game environment, the classic mode still uses the same questions and list of actions and targets the same objectives from the adventure mode to ensure that both game modes will deliver the same outcomes and results after playing the game.

The default game mode during classroom discussion is the adventure mode, however, the proponent decided to add the classic mode in order to add some sort of reviewer when the learners are outside the school. Inspired by flipped classroom models, this feature will transform students into self-directed learners. As good as it may sound, there are some weaknesses and challenges brought by this game mode. First, visual novels have a linear structure, and skipping parts of the narrative just to be able to jump into specific timelines is definitely a challenging part of the development. Obviously, it required additional time and effort. as if a separate game were needing to be built. Another downside is that it completely removes the opportunity of making the learners place themselves as the protagonist in the story because the story narration itself is being summarized to give focus on the lesson discussion. While the default mode is more ideal for children learning the topics for the first time, adding the classic mode will help as a reviewer.

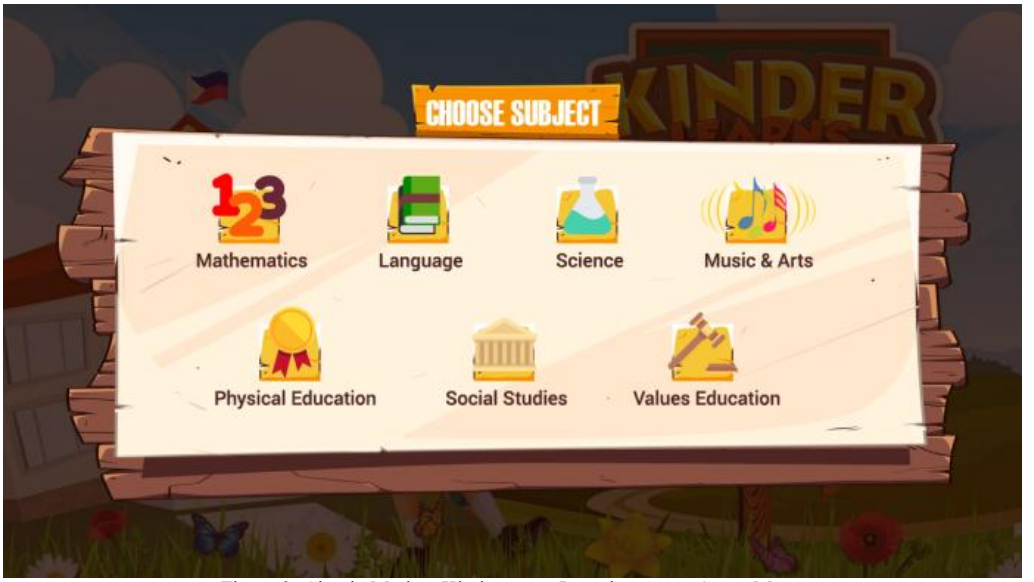

Figure 3: Classic Mode – Kindergarten Learning Areas Game Menu
Source: Garcia 2018

Gameplay

From Monday to Friday, Zander Blake attends the school. His teacher discusses the topics of the day per learning areas, and questions will be thrown to the whole class, just like a typical classroom setup, while the teacher is doing the same thing in the real world (Figure 4). The learner can answer the question which will alter the whole timeline leading to various gameplay variations as decision making will pop up in many parts of the story (as seen in Figure 5).

Figure 4: Mathematics Lesson – Counting Numbers
Source: Garcia 2018

Following the example on the provided game screens, another list of choices pertaining to the number definition will be presented when the learner chooses to answer the prior question. As mentioned previously, mistakes are encouraged by the game architecture, as it is an opportunity to showcase thematic feedback and reinforcement paradigm (Fotouhi-Ghazvini et al. 2009). In case the learner chooses not to answer the question, then the lesson will proceed, and the teacher will continue the lesson. During the discussion, several questions will be asked repeatedly to foster cognitive development and classroom engagement.

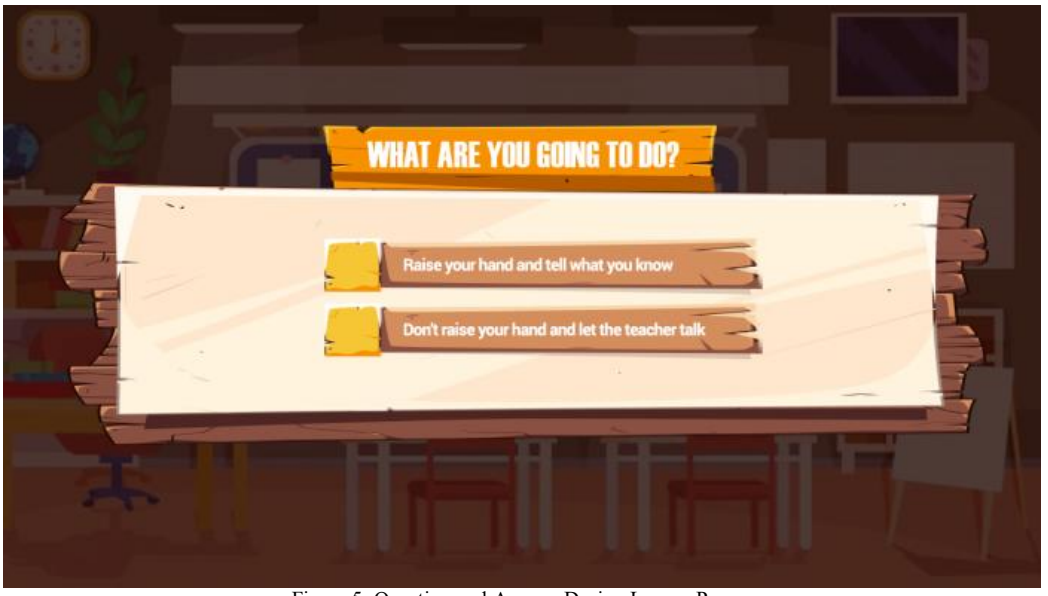

Figure 5: Question and Answer During Lesson Proper
Source: Garcia 2018

Methodology

Study Design

The approach employed by this study was constructive research where the creation of a novel construct, such as technique, algorithm, management tool, computer software, or process (in this case, a visual novel game), is needed in order to solve practical problems while producing an academically appreciated theoretical contribution (Pasian 2015). The final output aims to pre-empt a developmental delay in early childhood and/or help to fight an existing cognitive issue by enhancing knowledge through the use of game. The systematic development of Kinder Learns through the utilization of GAMED, a digital educational game development methodology, and its stages and sub stages, will be thoroughly discussed in the succeeding parts of this section.

To make sure that the proposed educational visual novel game will work in the real world, a pilot testing was done during the second quarter of the academic year 2017–2018. The pilot test was purposely performed to gather the feedback of the teachers (a subgroup in the intended sample) from the instructional material point of view, and to demonstrate how to play the game; the teachers were the ones to conduct the game evaluation, since their young students will easily respond to them than to the proponent. The evaluation feedback of kindergarten teachers, and their initial rating using a 3-point Likert scale (1=Not Applicable for Deployment, 2=Needs Improvement, and 3=Ready for Deployment), as can be seen in Table 1, were thoroughly considered to strengthen the impact of Kinder Learns before presenting it to the preschool students for the final game testing and evaluation. Among the twelve teachers, eight of them rated the game as "Needs Improvement," and the other four rated the game as "Ready for Deployment." Excerpts of some of the feedback, comments, and opinions can also be seen in Table 1, which were used for the improvement of the game.

For the final game testing and evaluation, the intended samples were the direct users of the game, both preschool teachers and students, who were recruited through the help of the division office. An approval for conducting the study and deploying the game within the classroom environment of different pilot schools was requested by the proponent. As part of the research ethics and information protection, identities of the students and teachers will not be revealed anywhere in this paper. The participants (N=272; 243 preschoolers, twenty-nine preschool teachers) played the main release of the game (version 1.0.12) and evaluated the game using the Serious Game Framework, which will be discussed in the succeeding part of this section.

Table 1: Sample Kindergarten Teachers' Initial Evaluation and Rating during the Pilot Test

Teacher Number	*Feedback, Comment, and Opinion*	*Initial Rating*
T1	The visual aspect of the game is appealing but it would be beneficial if the game will apply some sort of localization in terms of characters and places so that the students can easily relate to the protagonist and the environment.	2
T2	Kinder Learns is a perfect digital storytelling game for young students and its interactivity makes the learning fun. In my opinion, the use of digital visual novel game can be a powerful weapon for kindergarten teachers like me who are constantly dealing with playful kids every day.	3
T3	The background music and sound effects are all suitable for kids. The protagonist's voice sounded like a young boy but it also has an auto-generated diction like a robot which I think is not that friendly and relatable for kids.	2
T4	In my opinion, the question and answer portion in the game should be reinforced by having a short assessment like quiz or recitation at the end of topic presentation. Lessons in values education can also be incorporated (like an intermission) during the discussion of other learning areas.	2
T5	As a Mathematics teacher, I think the game will be useful for me if there are varieties in the examples in the lesson delivery. For instance, instead of using two balls as an example of 1+1, there should be other objects and practical applications when using the operation.	2
T6	I do storytelling in my kindergarten class every day. It is my most effective teaching technique to engage my students. The digital version of it will surely help me to engage more.	3

Source: Garcia 2018

Model of Development

Instead of using traditional software development methodology like most educational and visual novel game developers do, the proponent decided to utilize a digital educational game development methodology called GAMED. Aslan and Balci (2015) based the methodology off of the Digital Educational Game (DEG) life cycle, which consists of four phases: game design, game software design, game implementation and publishing, and game-based learning and feedback phase as shown in Figure 6. While this methodology is relatively new compared to well-established software development methodologies, the proponent believes that it is the more suitable framework when dealing with digital game-based learning as it is specifically created for educational game development and not on software or game in general.

Procedures of Development

Game Design Phase

Education Phase

As depicted in Figure 6, the starting point of the life cycle is the education problem domain. Developmental problems, be it social, behavioral, or learning difficulties, are very common in

preschool. If kindergarten teachers are the first line of defense to catch early signs and symptoms of a developmental delay, instructional materials are the first line of offense. During this phase, the proponent had a meeting with several preschool teachers to identify educational problems that pose challenges for learning and possible solutions to minimize, and if possible prevent, struggle down the road. According to the kindergarten teachers, children's cognitive development should be encouraged in a multi-faceted perspective by incorporating additional activities that combine fun and learning in their everyday routine.

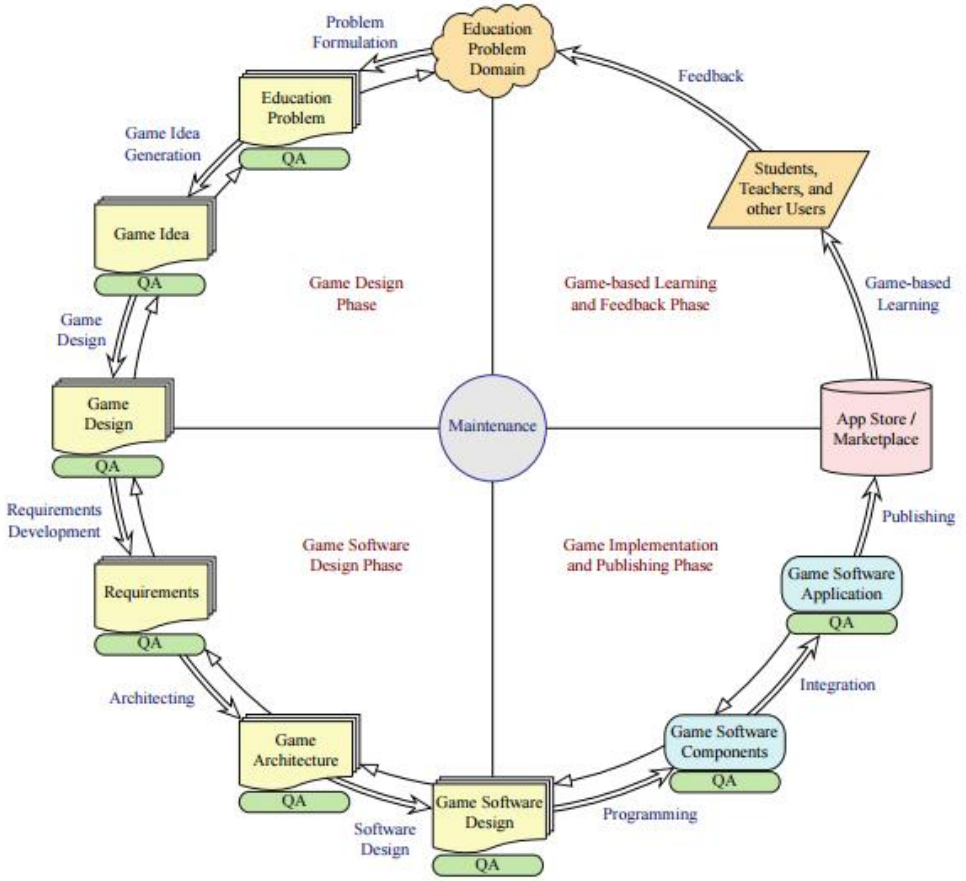

Figure 6: Digital Education Game Cycle
Source: Aslan and Balci, 2015

Game Idea

Fundamental decisions were made during this process. It is no secret that the direction of the game development starts from the game idea. During the meeting, reverse brainstorming was performed. Compared to the regular brainstorming that targets how to solve the problem, the meeting was focused on what causes the problem. Preschool teachers were then asked their usual techniques to engage students within the classroom environment. It was revealed that storytelling is one of the common denominators in terms of educational pedagogy used by the participants of the meeting. Therefore, it was an easy decision to incorporate storytelling as the knowledge delivery technique, only this time it will be digital and interactive. It was during this stage as well

when other game components, such as the genre and story setting were planned and decided, since these elements were going to dictate the graphic look and feel of the game, which is going to be a crucial element for the next development stage.

Game Design

As recommended by Aslan and Balci (2015), game design is best done using spiral game design strategy, which includes prototyping, playtesting, evaluation, and risk analysis as the major activities. In this process, however, the proponent decided to focus on designing game components such as content, gameplay, environment, storyline, and characters as spiral game design strategy requires a lot of manpower. The content part of the game is easier than the rest of the components since there is already a curriculum map from the Department of Education to be followed. For the game world, inartificial environments that students can relate to were used in the game such as schools, classrooms, libraries, parks, etc. Then, for the storyline, common preschoolers' experiences and children's behavior were used as a basis to structure the flow of the story. Lastly, for the characters, the proponent concentrated on story-driven character design rather than art-visual-driven character design since the genre is a visual novel.

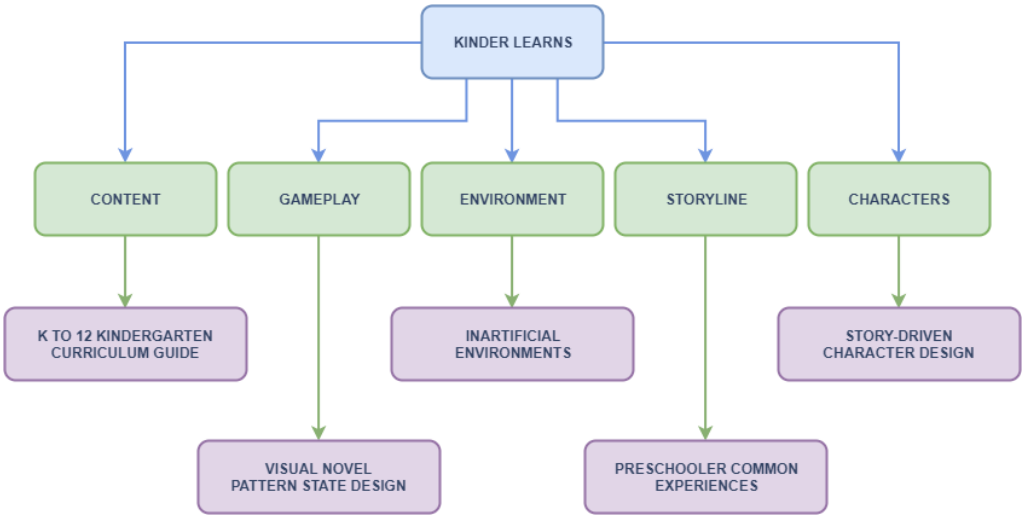

Figure 7: Component Decomposition of the Game Software Design
Source: Garcia 2018

Game Software Design Phase

Requirements

The elicitation of requirements for the development of Kinder Learns was done using case-based requirements development–a fundamental feature of the Unified Modeling Language (UML). Since the visual novel game will cover all the learning areas of Kindergarten, modularizing the complex game designs into a number of use cases is unquestionably bound to be beneficial and helpful throughout the game development. Through the decomposition of game functionality into use cases, the generation of both functional requirements such as gameplay, rules, features, and character limitations in the game world and non-functional requirements, such as usability, and interoperability qualities, were achieved in a short period of time.

Game Architecture

Since the game is in its infancy and the proponent is single-handedly doing all the work, it was decided to use a standalone system, rather than a network-centric system. In a standalone system, the game operates on a single device and does not have any interaction over a network. However, transforming it into a network-centric system will be part of the recommendation of this paper, as it will be a requirement in order to add several helpful features, such as a student progress tracker, automatic score recording, and a possible multiplayer game mode, to name a few.

Game Software Design

As noted in the requirements process, Unified Modeling Language (UML) will be used; therefore, it is highly recommended to utilize a modularization in this process. In a modularization approach, the game is divided into several modules: in this case, game features, which will be combined later on to bring a fully-working game. A state pattern which describes how an object can alter its behavior when its internal state changes (Gamma, Helm, and Vlissides 1995) was implemented since it is the appropriate behavioral software design pattern for visual novels. Each scene in the story will be implemented as a separate state. These states will then be combined to formulate the final game.

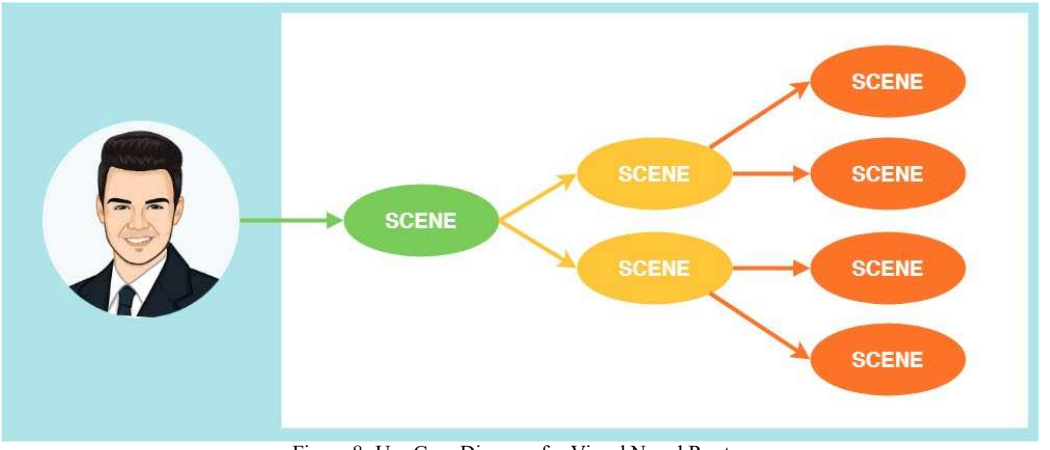

Figure 8: Use Case Diagram for Visual Novel Routes
Source: Garcia 2018

Game Implementation and Publishing Phase

Game Software Components

The game software components process revolves around the programming part of the game. When the game design phase is done, converting it to a working system by coding it one by one is the next stage. During this phase, the software designer can employ game engines to make the development process easier. For visual novels, one of the most popular engines is Ren'Py, a free and cross-platform engine for digital storytelling. The game engine makes it easier to combine media elements to create visual novels. The best thing about this engine is that the game will work in various operating systems, such as Windows, Mac OS, and Linux with Android and iOS as secondary platforms. Though the responsive resolution may be an issue, the game could also be played on most devices, including mobile phones and tablet PCs.

Game Software Application

Game module integration is the key to this process. Use cases created during the requirements process, followed by the modularization in the software design process, are integrated into an executable game to create the initial game software application. Instead of combining the modules all at once, it was decided to combine and link it one by one to reduce the integration risk, which is very common at this stage. After the unit testing that aimed to test each part of the game screens, integration testing was performed during this stage. The main goal of the integration testing is to test the units as a combined group or module.

App Store/Marketplace

At this stage, publishing it to a marketplace, like Apple Store and Google Play to gather feedback for the next phase is not recommended, as the game is still in its infancy and requires more iteration which, will be based from the feedback of its direct users. However, it can and will be done in the future date, since the DEG life cycle is iterative. Instead of relying on the users' feedbacks from a marketplace, the game software was privately presented to teachers to ask for their recommendations to improve the game. Furthermore, the game, at that moment, was designed specifically for the schools within the division.

Game-Based Learning and Feedback Phase

Students, Teachers, and Other Users

The initial evaluation in the pilot testing, with the help of teachers, was conducted to gather feedbacks and recommendations for the improvement of the game. This is an essential part of the game development life cycle and of the study in general since they will be the ones to use the game when it is finally completed. The common feedback revolved around the graphical user interface, voice audio integration, integration of assessment like quiz at the end of the lesson, some revisions on the lesson delivery, and longer story setup. All of these suggestions were considered to further enhance the final game. At this stage, another iteration was performed to add new features to the game based from the collected feedback.

Figure 9: Kinder Learns on Laptop, Tablet PC, and Smartphone
Source: Garcia 2018

Game Testing and Evaluation

The target population for the evaluation of the game was preschoolers and kindergarten teachers in seven pilot schools across Pasay City, Philippines, as they were the primary users of the final product. System testing and acceptance testing were the main goals during this stage. To understand the game performance and its impact as perceived by its primary users, the game was evaluated using the Serious Game framework (Yusoff, Crowder, and Gilbert 2010) which includes learning and pedagogy theory in combination with gaming requirements. This framework, an evolution of the input-process-outcome game model created by Garris, Ahlers, and Driskell (2002), constitutes a checklist that an educational game developer should employ as a foundation of covering all the necessary requirements in developing a digital educational game. Instead of creating a rubric from scratch, the proponent decided to use this framework since it is already a validated tool for effective learning. Looking at the composition of the framework and how it was formulated, the proponent chose this because of its elements, such as learner's capability, instructional content, intended learning outcomes, serious games attributes, learning activity, reflection, genre, game mechanics, and game achievement. In just one look at the attributes of the framework, one could argue that a visual novel genre could easily capture its elements and consequently pass the evaluation as most of these attributes exist in visual novel as its default game characteristics. However, the proponent still made sure that the literature review and the result of the pilot test will be incorporated in the final game software.

Table 2: Serious Game Framework Elements

Attributes	*Values for Learning and Education*
Incremental learning	Learning material is delivered incrementally. Additional new knowledge is delivered and not done all at once. It will have a proper start and end section. Learner feels and learns in a natural way and less complex.
Linearity	Learning will be in sequence. This will suit the sequential learner. However, due to the games flexibility, active learner can skip chapters
Attention span	This concerns with the cognitive processing and short-term memory loads placed upon the learner by the game. These loads need to be carefully calibrated to the target learner. Not to be overwhelmed and too long in the learning process.
Scaffolding	Support and help during learning within the games.
Transfer of learnt skills	Learnt knowledge to apply to other skills in the next level.
Interaction	Higher engagement, higher learning
Learner control	Active learning, self-study and self-exploration based on individual pace and experience.
Practice and drill	Repeating for harder task, better knowledge retention and can have plenty of game activities for drills
Intermittent feedback	Learner to reflect on what has been achieved so far and motivated for higher score (higher learning). Also using just in time feedback for learning.
Reward	Encourage learner and keep motivated. Negative reward as punishment within the game may also contribute to learning.
Situated and authentic learning	Learning where the learner can relate what is being learnt within the game to the outside world.
Accommodating the learner's styles	To suit and to reach out to different learner styles.

Source: Adapted from Yusoff, Crowder and Gilbert, 2010

Using a 5-point Likert scale (1=Strongly Disagree, 2=Disagree, 3=Neutral, 4=Agree, 5=Strongly Agree), the respondents evaluated the game using the same questionnaire. With the help of kindergarten teachers, the evaluation tool was administered to the young children, resulting in an efficient game evaluation. The teachers were also the ones who guided the students in answering the questionnaire by explaining each item. Following the same technique used by Garcia and Mangaba (2017), the questionnaire used in this evaluation considered the three to six age range; hence, the instruction of coloring a smiley face to indicate their answers using crayon was made to make the survey fun and suitable for children. A sample questionnaire was submitted prior to the day of evaluation to make sure that it is qualified and applicable for young students.

Results and Discussion

The development of Kinder Learns was conducted to provide a knowledge enhancement tool for early childhood education, and along with it is the reinforcement of the positive effects in using technology in early childhood education. Presented in Table 3 is the evaluation, indicating that the respondents show acceptance that this educational game can be implemented as an educational tool, and may bring significant contribution in transforming the traditional methods into ICT-based approach in a children-populated school environment. To combine the evaluation of both teachers and students (mean and SD) into a single group, the following algorithm and formulas were used. First and foremost, Σx= mean*n and Σx2= SD2((Σx)2/n)+(n-1) were applied for each group (Teachers and Students) of evaluation. Then the results were added together using tn= sum of all (n), tx= sum of all Σx, and txx= sum of all Σx2. Finally, the combined calculations used n= tn, mean= tx/tn and SD= sqrt((txx-tx2/tn) / (tn-1)).

Table 3: Serious Game Framework Elements

Serious Game Framework Attributes	*Teachers (N=29)*		*Students (N=243)*		*Combined (N=272)*	
	Mean	*SD*	*Mean*	*SD*	*Mean*	*SD*
Incremental learning	4.96	2.4	4.82	3.2	4.83	3.12
Linearity	4.90	3.4	4.88	3.5	4.88	3.48
Attention span	4.75	1.8	4.78	2.1	4.78	2.07
Scaffolding	4.57	1.9	4.23	1.7	4.27	1.72
Transfer of learnt skills	4.66	2.2	4.50	1.7	4.52	1.76
Interaction	4.87	4.1	4.58	2.1	4.61	2.39
Learner control	4.72	1.2	4.30	1.9	4.35	1.80
Practice and drill	4.12	3.2	4.34	2.9	4.32	2.93
Intermittent feedback	4.89	4.3	4.92	5.1	4.92	5.01
Reward	3.86	0.9	3.54	1.1	3.57	1.08
Situated and authentic learning	4.01	2.2	3.89	1.2	3.90	1.34
Accommodating the learner's styles	3.79	0.8	3.55	0.9	3.58	0.89

Source: Garcia 2018

Because of the nature of a visual novel game genre wherein a scene-by-scene setup is used to deliver the story (in this case, a story with a lesson), the incremental learning attribute where knowledge is delivered incrementally was easily attained. It is this very nature why the game software design, as discussed in the previous section, used a modularization approach. With Kinder Learns, the learner feels and learns in a natural and less complex way mainly because of uncomplicated game mechanics and straightforward narrative as proven by McLaren et al. (2017) which leads to the attainment of transfer of learnt skills attribute. Without this, children will not perform well because they often do not remember tasks that require complex or multiple steps (Bilal and Kirby 2002). To support this attribute, the game architecture increases complexities once the students mastered the required skills as verified by Hanna et al. (1998).

Another characteristic of visual novels is the storytelling, which is the primary reason why the game easily achieved both the linearity and situated and authentic learning attributes. The adventure game mode delivers the lesson in sequence which suits sequential learners. On the other hand, the linearity attribute seeks flexibility in the software design that will allow the active learners to skip chapters, hence, the creation of classic game mode. The classic game mode also allows self-exploration, which captured the learner control attribute. This is essential, since children are more engaged when they feel they have freedom of control (Geist 2014), as they are naturally curious and enjoy exploration (Hanna et al. 1998). Both of these game modes were the reason why the accommodating learning styles attribute was attained.

The next attribute, attention span, was achieved as well, as learners' experience memory bursts upon playing the game, but not in such a way that it is too long and overwhelming. The game has also instructions scattered throughout the story which support and help during learning. Because of this, the scaffolding attribute was achieved as well. Following the advice of the mathematics teacher of having different examples during the pilot test, the game also achieved the practice and drill attribute. Moreover, the thematic feedback and reward as reviewed in the literature (Fotouhi-Ghazvini et al. 2009) were incorporated into the game; that is why the intermittent feedback attribute and reward attribute were both covered in the game architecture. Lastly, the interaction attribute was also accomplished by combining various media elements, such as visual or audio cues, to convey information for higher engagement and learning, which is also suggested in the report of Chiasson and Gutwin (2005). Overall, all elements from the Serious Game framework were achieved by Kinder Learns visual novel game.

Based on the rating obtained through game testing and evaluation, the result of the evaluations from 272 respondents supports the acceptance of Kinder Learns as an educational tool for knowledge enhancement in preschool. Features from the games reviewed in the literature, as well as the initial feedback and recommendations of the kindergarten teachers, have hugely contributed to the success of the final game build. The proponent accomplished the objectives of designing and developing an educational game intended for preschoolers. This educational visual novel game, Kinder Learns, is acceptable to its users and shows a promising potential that it could be implemented within the school and other educational institutions.

Conclusions and Future Works

This paper has successfully completed the systematic development of an educational visual novel game. Consequently, Kinder Learns was authenticated as a potential educational tool that could stimulate children to widen their horizons and enhance their knowledge. Educational technology has indeed established its presence in most parts of the education sector, however, the use of preschool technology is still considered under-used at the kindergarten level as the vast majority of educational leaders and preschool teachers are vigilant with potential dangers. Nevertheless, the development of Kinder Learns is grounded from a digital educational game development, and the evaluation of both kindergarten teachers and students through the utilization of Serious Game Framework shaped a realization that technology has a place in early education landscape.

Therefore, it is recommended for educational leaders and early childhood educators use, or at least consider using, Kinder Learns as part of the classroom curricula to promote pupils' knowledge enhancement. This will reinforce the positive influence of employing a digital game into the classroom setting of preschool education, as initially demonstrated by Burgul and Yağan (2009) and Nacher, Garcia-Sanjuan, and Jaen (2016), and the unequivocal perceptions of school stakeholders towards technology use in early education years (Ihmeideh and Alkhawaldeh 2017). For future researchers of digital game-based learning, this paper suggests that digital educational games are a valid preschool technology, and visual novel as a game genre, albeit not commonly used in the education sphere, has proven its potential when used for educational purposes.

For future works, the proponent is planning to extend the functionality of the game. As the game contents were only focused on the first seven lessons per learning areas of the Kindergarten Curriculum Framework (KCF), expanding it into a full-blown visual novel game covering an academic year's worth of lessons, activities, and assessment materials is expected to fully help the teachers in implementing the preschool's educational goals into practice. Integrating the digital visual novel game with e-learning technology is also part of the consideration, since e-learning is widely adopted in the Philippines (Garcia 2017). The result of the study is not generalizable; however, the use of video games in early childhood education, and the use of visual novel as a genre of an educational game are both worth exploring. At a future time, the proponent plans to conduct a comparative experiment using the digital visual novel game, Kinder Learns, as the intervention to assess its influence towards preschoolers' academic performance.

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