

Digital Storytelling Framework to Assist Young Children in Understanding Dementia

Noreena Yi-Chin Liu¹

Faculty of Arts and Social Sciences
Universiti Brunei Darussalam
Brunei Darussalam

Nooralisa M Tuah²

Faculty of Computing and
Informatics
Universiti Malaysia Sabah
Malaysia

Kevin Chi-Jen Miao³

Faculty of Design and Creative
Technologies
Auckland University of Technology
& Blossom Lab
Taiwan

Abstract—A digital storytelling tool is one of the interactive technologies that can help youngsters better comprehend Dementia. Dementia makes it difficult for older people to maintain their daily routines. They have difficulties in effectively communicating with those around them. Similarly, children whose grandparents have Dementia will struggle to understand their grandparents' situation. It will also negatively influence children's relationships with their grandparents. Learning through interactive digital storytelling will affect younger people's entertainment experiences, which may help them better comprehend Dementia. As a result, the children's relationships with their grandparents may be strengthened. This study aims to present the framework of digital storytelling in helping young children understand more about Dementia. The framework was developed in a step-by-step procedure that included analyzing and synthesizing current applications and relevant research, constructing the framework, and having it confirmed by experts. Researchers and developers may use the framework as a guideline to build meaningful digital storytelling features.

Keywords—Digital storytelling; Dementia; interactive learning; entertainment experience

I. INTRODUCTION

Dementia is one of the most common public health concerns among the elderly. Most of the research on Dementia treatments focuses on mental health assistance. When a patient is diagnosed with Dementia, it usually affects their family [1]. Children are particularly vulnerable because they lack the necessary information to understand Dementia. Maintaining a relationship with grandparents is difficult for youngsters since they don't know what to say or how to act [2].

Dementia technology intervention has been widely used. Healthcare tracking devices [3], brain training [4] and rehabilitation platforms [5], and predictive analytics and diagnosis [6] are all examples of its applications. Fitbit, Apple Watch, and other personal GPS trackers for the elderly are among the most popular interventions on the market for health tracking gadgets that could be utilized for Dementia treatment. Fitbit is a wearable device that tracks activity, exercise, diet, weight, and sleep to help individuals stay motivated and improve their health. Meanwhile, *BoundaryCare* is a location and health tracking software for Apple's iWatch and iPhone. The apps were created with Dementia in mind, but the apps also may be used to track other cognitive issues, including

Down syndrome and Parkinson's disease. Various devices can be used as personal GPS trackers for the elderly in addition to these. *Mindmate* and *Lumosity* are two other Dementia interventions that can be further considered. These apps are among the various brain training and rehabilitation platforms accessible.

Brain training is one of the most significant parts of improving Dementia symptoms [7]. According to this perspective, the applications are intended to prevent Dementia by training in cognitive processes such as speed, memory, attention, problem-solving, and others. Furthermore, numerous studies in the literature focus on having a mobile application to reduce cognitive impairment among patients [8]. This technological solution aims to improve a person's Dementia status by providing improved treatment support.

Within these five years, the United Kingdom's government, organizations, and communities began an educational information campaign regarding Dementia for the public, focusing on Dementia in family members, for example, the Dementia Friend, the Alzheimer's Association, and the Alzheimer's Disease International. However, the available resources for children are fairly restricted since, at times, children may find it difficult to understand owing to a language barrier that prevents them from grasping the situation. As a result, a more targeted intervention or programme to assist youngsters in understanding Dementia and how to care for their grandparents with Dementia is required. Furthermore, this arrangement will help the children maintain their bond with their grandparents.

It has been discussed who, when, and how to inform children and young people about Dementia. Dementia Friends proposed five key messages about Dementia to help them understand what Dementia is and what a diagnosis means for their relationship: 1) Dementia is not a natural part of ageing, 2) Dementia is caused by diseases of the brain, 3) Dementia is not just about losing your memory, 4) It is possible to live well with Dementia, and 5) There is more to the person than the Dementia. These five stages are the first to learn about Dementia, and an interactive version may also be utilized for youngsters.

Children today are exposed to technology and digital information from an early age. As a result of their early

exposure, they are more comfortable spending time interacting with digital information. The interaction is either for education, entertainment, or a change of lifestyle. Online learning has become the new standard for encouraging self-learning in schools. One of the online learning methodologies, digital storytelling, is regarded as helpful in raising children's motivation [9]. Furthermore, learning using interactive methods such as digital storytelling can aid in developing children's brains [9].

Education and computer application research is now generating a lot of interest in enhancing teaching and learning activities and raising children's productivity. Digital storytelling for Dementia may help youngsters comprehend the situation better [10]. In general, digital storytelling is a narrative style that combines digital pictures, texts, sounds, and other interactive components [11]. Digital tales are typically two to 10 minutes long. They are often saved in digital form and posted to internet sites where they may be viewed with web browsers [12].

Digital storytelling is also defined as short personal stories created with computer software and shared with others to transmit ideas, facts, and views on a wide range of subjects and themes [13]. They're also referred to as picture books [14] and are made up of various digital stories. According to Robin [13], the applications of digital storytelling may be divided into three categories: 1) personal narratives: stories about significant events in one's life; 2) historical documentaries: stories about critical events that help us understand history; and 3) stories that enlighten or instruct the viewer on a particular subject or practise. The application of Dementia to these domains might fall into one of three categories.

As children became more involved in and influenced by digital storytelling material, it is imperative to examine a relevant framework that can guide designers and developers on the appropriate design and development of digital storytelling [13]. Although many academics investigate the design and development of digital stories and picture books, they are mainly focused on specific issues and traits, particularly when developing an interactive tool. There has been minimal research on the appropriate content and design of stories for young children, especially when it comes to Dementia prevention via a digital picture book. There is presently no comprehensive framework that researchers and developers may use as a guide to compare and select relevant parts for digital storybooks. As a result, a comprehensive digital storytelling framework must be developed to create practical guidelines in the future. Therefore, to develop the framework, this paper will address the following:

- To analyze the current implementation of digital storytelling for young children in an online learning environment.
- To identify the essential elements of storytelling to motivate young children's engagement in online learning environments.
- To develop a suitable framework of digital storytelling for young children that can guide designers and

developers on the appropriate design and development of digital storytelling tools.

This paper is organized as follows. The research underpinning interactive learning in digital storytelling is presented in Section 2. In addition, the experiences of involvement and amusement in digital storytelling are described. The many tools for implementing digital storytelling are outlined as well. The discussion of approaches to adopting digital storytelling in education is also presented in Section 2. Section 3 offers the development of the framework. The framework validation research is discussed in Section 4, and Section 5 discuss the result obtained from a focus group discussion with experts in the field. Finally, Section 6 concludes with some remarks on the study's significance.

II. RESEARCH BACKGROUND

A. Digital Storytelling and Interactive Learning

Digital storytelling is a method widely applied for interactive learning in which it could help to increase students' motivation to learn [13],[15], and it could evoke a sense of entertainment in learning [13]. Digital storytelling can also be viewed as an interactive platform that leverages information visualization to provide fun learning. Interactive learning is a merging technology in traditional education. It provides students with a platform to interact with the content in the learning process. The digital story also plays as a communication tool that conveys information between a teacher and their student based on the interactive story. In this environment, the student's role in the course changes from a passive receiver into an active participant. Interactive learning usually involves social networking. Community on social networks allows students to easily and effortlessly access the learning material, and learn from teachers and other students.

When digital storytelling is used for educational purposes or used for conveying knowledge and ideas, the environment becomes part of an interactive learning platform. Digital storytelling typically transmits stories in the form of a video as it can be readily shared to reach a larger audience [16],[17]. Students and teachers can easily access and share content using social media sites like Facebook and Twitter. Furthermore, students can respond to these digital stories by leaving comments and sharing them. To some extent, they could be able to interact with others when utilizing the provided content. It is believed that the determination to get attention on social media is the kind of reason for the students to get engaged with the digital storybook. Having a good internet connection and tools, on the other hand, is regarded as critical in interactive learning since it determines the ease with which students may gain knowledge both online and outside of class. These technologies function as interactive learning components, substantially altering the engagement between teacher and student.

Apart from that, one of the advantages of digital storytelling is that it can be generated using various media, including video, photos, audio, and music, to build a rich content project. Such inventions may provide viewers with a more profound sense of amusement and excitement when

viewing. As a result, digital storytelling has been applied to various disciplines to reach a wider audience or provide more profound knowledge. Digital storytelling, for example, is used in education to stimulate students' interest in learning and museum tours to enhance the tour experience.

B. Digital Storytelling in Different Fields

Digital storytelling approaches have become increasingly popular in recent years as the barrier to entry has lowered. Teachers have used it at many school levels to improve students' learning experiences and increase their interest and motivation in the course [18]. Digital storytelling is also used in various domains, such as health care, ageing, and social issues [19].

1) *Digital storytelling in school*: Teachers worldwide have incorporated digital storytelling into their classes to aid in teaching and improve their students' learning experience. Digital storytelling has the potential to stimulate students' interest in learning and boost their drive to learn [15]. Students will benefit from the process of producing a digital story because the goal of a digital story is usually to deliver a message. Students would need to improve their communication abilities to create a digital story. In this way, they learn to arrange their thoughts and create narratives [12]. Creating a digital story might encourage kids to think creatively while improving their cultural literacy [20].

2) *Digital storytelling in museum*: Digital storytelling, as a form of multimedia that combines audio and video, may be more appealing and exciting than traditional oral communication. For example, digital storytelling in a museum tour guide's tour could enhance the tour experience and narrative for guests. Digital stories developed for the museum could serve various functions, like offering advanced information about the exhibition's showpieces or answering visitor queries [21]. For a more engaging and personal tour experience, museums merge digital tales with modern technologies such as smartphone applications, augmented reality, virtual reality, and more.

3) *Digital storytelling in community and non-profit organization*: On the social networking site, digital stories are straightforward and easy to share. As a result, communities and non-profit organizations frequently use it to spread their messages and raise public awareness. For example, a local government-sponsored awareness campaign might simply use and share the stories on social media sites like Facebook, Twitter, and Instagram. Furthermore, digital storytelling can make a complex or abstract subject more understandable for individuals. As a result, it has the potential to attract a more extensive range of people's attention [22].

4) *Digital storytelling in healthcare*: In health care, digital storytelling could be used as an educational tool to assist patients, their families, and caregivers understand their condition. Patients or their families who have gone through a challenging time, difficulties, or trauma due to illness could share their stories and offer advice. This information can be presented as a digital tale. Patients and their families may find

that sharing their tales is a powerful and emotional tool that can help them cope with the pain and challenges they may encounter in the future. It arouses a sense of empathy among caregivers toward their patients indirectly [23]. Hardy & Sumner [10] advocate for patients, family members, and caregivers to create digital tales based on their experiences with physical and mental disorders such as arthritis and Dementia. People who have lived through or experienced a similar event benefited from the digitization of stories.

C. Engagement and Digital Storytelling

Children are exposed to various stories as they grow up, influencing their behaviour and acceptance of their surroundings. Children appear to be able to process and grasp complex information through narrative and apply it wherever possible [9]. Digital storytelling, enabling youngsters to learn something, has been proved to be an effective strategy in studies [9],[13]. This is because visual signals may assist children in focusing and thus become more engaged with the content. As a result, engagement, engrossment, and absolute immersion have been proposed as three levels of immersion [24].

- **Engagement**: The term "engagement" refers to both cognitive and emotional states [25],[26]. The interaction encourages the user to use the platform, or at the very least be aware of its existence, and piques the user's interest in digital technology, particularly game theory. Forcing anyone to use the platform, especially young children, is unconstitutional. Rather than forcing them to utilize any digital technology, they should be encouraged to do so. It will have a negative influence, and its monetary value will be lost. Engagement aims to provide a personalized experience through a platform that will attract and spark people's interest [25].
- **Engrossment**: The user may become highly absorbed and engrossed due to the involvement [24]. A game-created environment can be entered, explored, enjoyed, and defended by users. The player becomes an integral part of the game, and the game immediately impacts their emotions. At this point, players want to keep playing, which allows them to achieve complete immersion [27].
- **Total Immersion**: The final immersion stage is total immersion [24], which occurs when the user is fully immersed. The most important aspect of total immersion is paying attention. In video games, there are three types of attention: visual, aural, and mental. Combine visual and auditory elements to create an ambience that directs the user's experience [27]. Users must pay close attention to sound and vision, which requires extra effort. Consumers become more engrossed as a result of increased attention and effort.

D. Digital Storytelling Tools

There are three different types of tools for generating digital stories. 1) Computer-based software programmes.

2) Tools that can be accessed via a web browser. 3) Apps for mobile devices such as smartphones and tablets [12].

- **Computer-based Tools:** Computer-based tools are software programmes that run on Windows or Mac OS X. They're most commonly used for non-linear editing. The basic functionality of free tools like Windows Movie Maker or iMovie for Mac is necessary to make digital stories. For the construction of digital storytelling, video and audio editing are sufficient. Paid editing applications with greater functionality, such as Adobe Premiere and Final Cut Pro, include transitions, filters, special effects, and more. Globally, computer-based tools have the most users. As a result, many online resources, such as articles, video tutorials, and online courses, explain how to utilize and create.
- **Web-based Tools:** Web browsers are used to generate these tools. As a result, it is useful for users whose operating systems are continually changing. The utilities are compatible with various operating systems, including Windows, Mac OS X, and Linux. After logging in with a web browser, the data will be synthesized for further processing. WeVideo is the most widely used of these tools. WeVideo, launched in 2011, offers the most functions and is similar to computer-based technologies.
- **Applications for iOS or Android:** In recent years, many people have switched from PCs to mobile devices as their primary means of work. As a result, professional editing apps for smartphones and tablets are now available. Some, including Adobe Premiere Rush (for iOS and Android) and iMovie for iOS, have grown from computer-based software. These apps are designed for users who are already comfortable with smartphones or tablets and are great for producing digital stories with limited content.

E. Digital Storytelling as Entertainment Approach

Digital storytelling is an approach to telling stories through digital technologies. It is considered a fun and entertaining approach when involved with technology. The story will be digitalized and designed with sound, video, or some interactive activities. Also, some are installed with external devices for enhanced learning. Following Hardy & Sumner [10], the storytelling is digitalized in six steps: writing, script, the storyboard, locating multimedia, creating the digital story, and sharing.

The first step is about writing activity. The purpose of this step is to introduce a personal narrative and the main idea for the storytelling. Scripting comes next in step two. It has been refined, and the elements of the narrative story have been defined. Step three is the creation of a storyboard. The storyline for each scene in the storybook will focus on this step. Through a succession of visuals, the storyboard will define the specific aspect and segment of the plot. The next stage is to locate Multimedia, which is the fourth phase. Step four is collecting the materials, which comprise sounds, films, music, graphics, pictures, and images, among other things. Then, in step five, create the digital story. Users will create

their stories using technology or software at this level. Step six is the final step, which is to share. It is critical to share user tales and solicit audience feedback. The digitalizing phases illustrate that when creating a digital tale, the storyline, the fun component, and the entertainment effect were all considered to make the story appealing and impactful to its intended audience.

Learning through entertainment is a valuable method for children because it helps draw their attention and imitate their experiences while learning. Learning and enjoyment are combined in one platform with digital storytelling. Whether digital storytelling is about pleasure, emotion, or suspense, it will interest its readers passively, actively, or enormously [28],[29]. Games, immersive technologies, and artificial intelligence technology can all be used to understand this type of involvement.

- **Digital Storytelling in Games:** In recent years, many people have switched from PCs to mobile devices as their primary means of work. As a result, professional editing apps for smartphones and tablets have been developed. Some, like Adobe Premiere Rush (for iOS and Android) and iMovie for iOS, arose from computer-based applications. These apps are designed for users who are already comfortable with smartphones or tablets, and they are great for producing digital stories with limited content.
- **Digital Storytelling with Immersive Technology:** Augmented reality (AR), virtual reality (VR), and mixed reality are examples of immersive technologies (MR). These techniques create a more immersive interaction experience [30], opening more possibilities in content creation, including digital storytelling. Virtual reality (VR) applications for digital storytelling with immersive technologies are the most common. VR is presented via a head-mounted display, allowing users to experience a fully simulated virtual environment. Some forms of digital storytelling will enable the audience to participate. The audience, on the other hand, is primarily passive and consumes the author's substance. In digital storytelling, VR could allow the audience to participate in the environment and provide a direct response to the event [31]. The audience can participate in digital storytelling made in VR. "In the future, you will be the character. The story will happen to you," said Chris Milk, an immersive artist. [32].
- **Artificial Intelligence Techniques in Interactive Digital Storytelling:** Artificial intelligence (AI) has traditionally been used in video games to enhance digital storytelling. These games give players various options for what the main character does, giving them the feeling of being the story's protagonist. AI would then shape the tale based on the player's decisions. Among the AI approaches are case-based, FSM, genetic algorithms, goal net and fuzzy cognitive mapping, natural language processing, and search algorithms [33].

III. DEVELOPMENT OF THE PROPOSED CONCEPTUAL FRAMEWORK

A. The Framework Development Process

The conceptual framework was developed according to the previous literature review. The research field includes digital storytelling, learning cycle, technology intervention and user engagement. Fig. 1 depicts the four processes involved in developing a framework. The initial stage is to summarise and list the aspects and define the main elements based on the existing literature. According to theories in serious games, interactive technologies, and learning cycles, the second stage is to group the pieces into interactive learning. In this study, the third phase is to build up the elements of digital storytelling. Discussions about technology theories relate to the digital storytelling platform at this point. The framework is built at the last stage.

B. List of Elements

Interactive learning and digital storytelling are the two elements of the framework. This section separates the satisfaction of needs in interactive learning and the satisfaction of requirements in digital narrative design. The concept of interactive learning is derived from the theoretical learning cycle and serious gaming, as shown in Table I. Education, engagement, and amusement are three components of interactive learning that are relevant to the primary goal of the research. Each component contains three elements. The first component, education, has three components: empowered learning, problem-based learning, and deep knowledge. The second component is engagement, which has three levels: engagement, engrossment, and ultimate immersion. The third component is entertainment, including passive, active, and immersive forms.

Table II depicts Lambert's digital storytelling concept [12], which includes the seven components of digital storytelling and the establishment of the San Francisco Center for Digital Storytelling. However, the consumers in this study are children who are not suited to complex design. As a result, the five critical factors for launching digital storytelling pique children's interest while also providing an easy-to-use platform in Table II.

C. Group Elements of Interactive Learning

Education, engagement, and entertainment are the three components of interactive learning. Educational components are concerned with the learning process; engagement components are concerned with the amount of engagement; and entertainment components are involved with the entertainment experience. The proposed components are based on game theory, learning cycles, and the realm of immersion technologies.



Fig. 1. Framework Development Process

TABLE I. ELEMENT OF INTERACTIVE LEARNING

Components	Elements	Description
Education	Empowered Learning	To help the user's motivated to complete tasks.
	Problem-Based Learning	It develops problem-solving skills and critical thinking skills.
	Deep Understanding	Every decision and action have a meaning, also called meaning as action.
Engagement	Engagement	Invite the user to use or know the platform exists and bring the user's interest.
	Engrossment	The user becomes deeply involved and becomes engrossed. So, the user's emotions will be affected.
	Total Immersion	The Final stage of immersion is total immersion, when the user is fully engaged.
Entertainment	Passive Entertainment	It lacks the interaction of the user or viewer.
	Active Entertainment	Increases the user's participation and expectations that they have different reactions to respond to different situations.
	Immersive Entertainment	Immersive entertainment comes with immersive technology such as Virtual reality (VR) and Augmented Reality (AR).

TABLE II. LEARNING ELEMENTS OF DIGITAL STORYTELLING

Elements	Literature
Setting	It refers to the physical location, including time, action, place, etc.
Characters	The most often-used cartoon or animals as characters. It also can affect the story
Plot	It is related to the storyline.
Conflict	It brings the challenge of problems that affect the action of the story.
Resolution	It is the underlying insight which is the message of the story.

- Education-Learning Process: Kolb's learning cycle [34] and Gee's ideas for learning games [24] were used to guiding the learning process. These theories look at the deep learning cycle from a user's perspective, allowing them to apply their knowledge to new areas or solve challenging problems. Empowered Learning, Problem-Based Learning, and Deep Learning are the three stages. Empowered Learning, Stage 1: Empowered Learning is the first stage in motivating or encouraging people to use the platform. It is vital at this stage to pique users' interests to finish the work, and as a result, users will continue to use the platform. Stage 2: Problem-Based Learning: During this stage, the user will get experience in solving problems. Stage 3: Deep Understanding: Users must comprehend the meaning of each decision and action to attain deep understanding.

- **Education-Engagement Level:** The purpose of the engagement level is to assist the user in becoming more engaged. It has been debated in serious game theories as to how to create higher-quality serious games. Gee [24] hypothesized three immersion levels: engagement, engrossment, and ultimate absorption. Stage 1 Engagement: This is the stage in which the user is invited to utilize or become aware of the platform and pique their curiosity. The user begins to devote time, effort, and focus. Stage 2 Engrossment: Following the previous stage, the user becomes more immersed and captivated, which has a direct impact on the user's emotions. Total immersion is the third stage, which describes the circumstance in which the user is completely immersed. Total immersion is the final immersion stage and impacts the user's ideas and feelings. Aside from that, one of the most significant aspects of immersion is paying attention.
- **Entertainment – Entertainment Experience:** Entertainment Experience has been considered across various platforms, including video, games, and film [29]. Oliver & Bartsch [35] stated that theories on the entertainment experience are divided into three categories: Suspense, Appreciation, and Fun [28],[29]. According to Hall [36], suspense is related to the tension and excitement experiment. Whereby fun refers to enjoyment, appreciation relates to user experience, and suspense refers to the anticipation and excitement experiment. It resembles three cinematic elements: light, serious, and action-oriented [29],[35]. These theories are also similar to the "engagement Level", which has been discussed in the previous section. However, the conceptual framework proposed in this study is for digital interactive learning. Thus, the entertainment experience has been refined within three stages: Passive Entertainment, Active Entertainment and Immersive Entertainment.

1) *Stage 1 passive entertainment:* Passive entertainment lacks the user's or viewer's interaction. It is a type of entertainment produced by others and distributed to others, such as viewing movies or reading a book.

2) *Stage 2 active entertainment:* As the name implies, active entertainment places a premium on your participation and requires you to react and respond to various scenarios. Active entertainment, such as decision-making or character control in video games or interactive digital storytelling, will involve your participation rather than passive entertainment.

3) *Stage 3 immersive entertainment:* Immersive entertainment is a brand-new idea that has emerged as a result of the advent of immersive technology. Virtual reality (VR), which requires the user to interact with a VR headset and VR controller for an immersive experience, is an example of active entertainment with a higher interactive level and immersive simulation.

D. Relationship between Components

This section discussed the relationship between interactive learning components: 1) Interest links education and

entertainment, 2) Immersion links engagement and entertainment, and 3) Interactivity connects education and engagement. We illustrate the interrelationship of these three components in Fig. 2.

1) *Education – entertainment (interest):* It is already termed in serious games called "Edutainment". However, the best association is "Interest". The more entertained they are by the APP (Games), the more interested the users will be in the learning content conveyed.

2) *Engagement – entertainment (immersion):* The similarity between "Engagement" and "Entertainment" is in trying to approach the immersion stage, which brings the user totally involved with the platform.

3) *Education – engagement (interactivity):* Interactivity increases engagement and brings users' attention. Thus, "Interactivity" enhances the learning process to provide an in-depth education system.

E. A Set of Elements for Digital Storytelling

Digital Storytelling has five elements: Setting, Characters, Plot, Conflict, and resolution. The detail of each component is described in the following Table III.

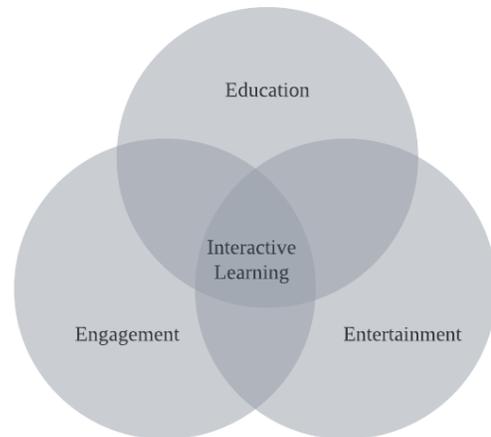


Fig. 2. Framework Development Process.

TABLE III. ELEMENTS FOR DIGITAL STORYTELLING

Elements	Description
Setting	A story's setting refers to the physical location and includes the time, action, place etc. For example, historical stories.
Character	It depends on the story. People or animals are most often used as characters. Characters can also affect the story, such as some characters are set up as heroes who have a sense of fair play.
Plot	It is related to the storyline. The plot usually begins with a problem and resolves it at the end of the story.
Conflict	Most of the story requires conflict, which brings the challenge of problems that affect the action of the story.
Resolution	Resolution refers to the underlying insight to find out the "message" of the story.

F. Constructing the Framework

The framework's construction follows the previous part and is divided into three stages, as follows:

Stage 1: The framework is established based on the understanding of interactive learning elements and the components of digital storytelling in constructing a digital storytelling application for promoting Dementia among young children. The framework is established into two sections: interactive learning and digital storytelling.

Stages 2: After establishing the essential component of the framework, the following step is to identify the sub-components for each of the components established for interactive learning – education, engagement, and entertainment. Following the discussion of the education component in Section III(C), the sub-components of the learning process comprise empowered learning, problem-based learning, and deep learning. The sub-components of engagement also discussed in Section III(C) include engagement, engrossment, and total immersion. For the entertainment component, the sub-components contained the entertainment experience, passive entertainment, active entertainment, and immersive entertainment. The relationship between these components was also mentioned in Section III(D). We illustrate this relationship in Fig. 3.

Stage 3: Establishing the connectivity of interactive learning and its requirement for digital storytelling. This study

aims to learn more about how this connectivity has a significant impact on the promotion of Dementia in young children. The digital storytelling element mentioned in Section III(E) is related to technological advancement. The framework of this study is formed by combining the theoretical aspect of interactive learning and the technical part of digital storytelling in Fig. 4.

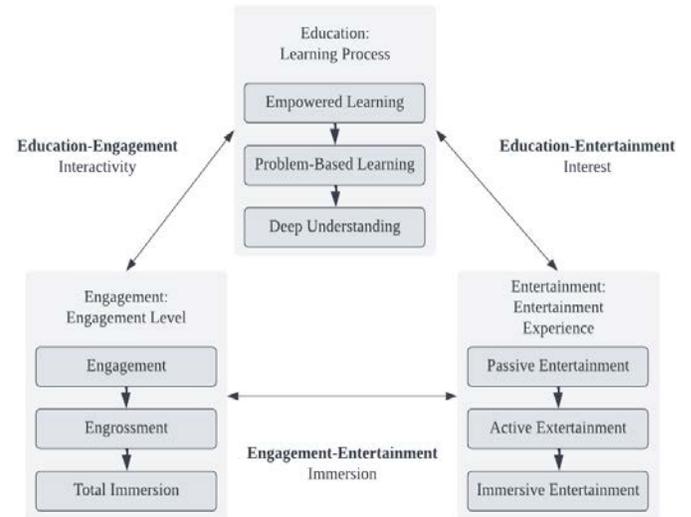


Fig. 3. Component and Sub-Components Relationship Establishment.

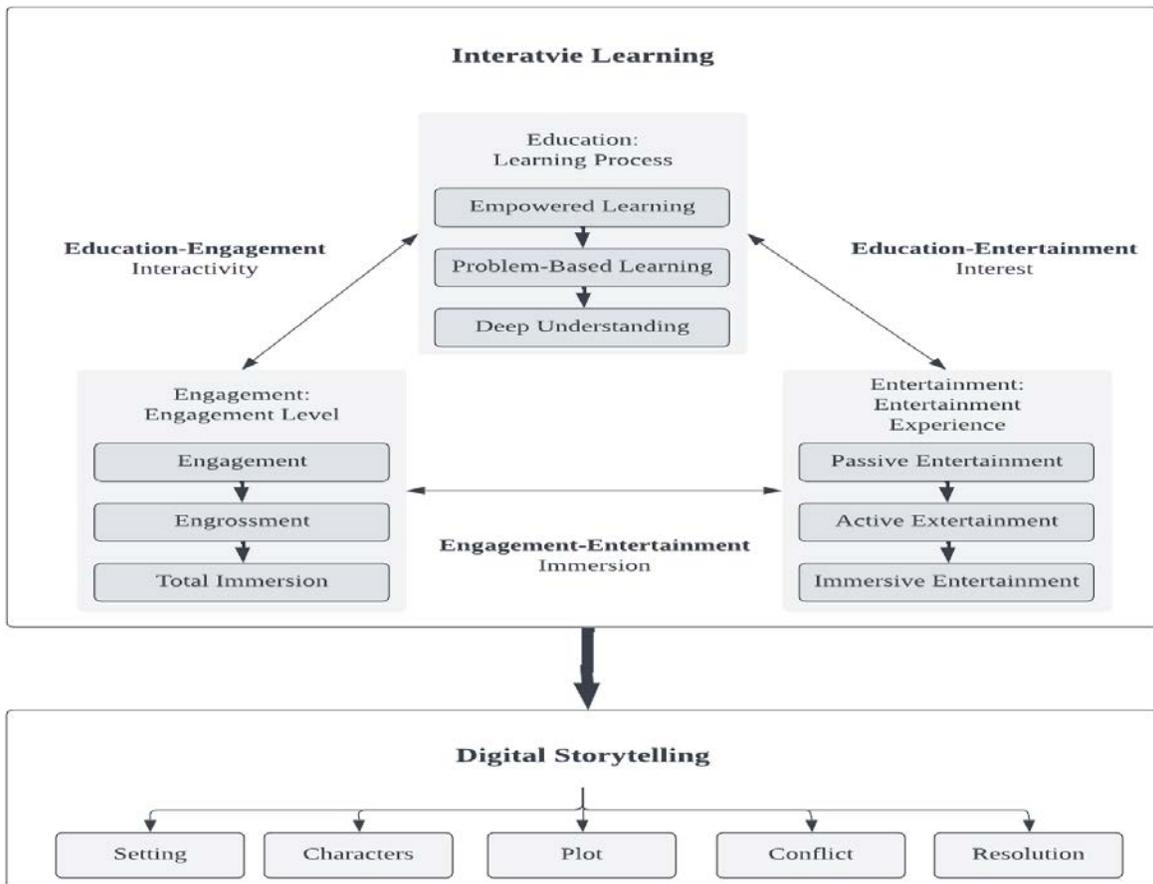


Fig. 4. Digital Storytelling Conceptual Framework.

IV. FRAMEWORK VALIDATION

Research methods are procedures for collecting and analyzing data. There are various research methods for different types of research. The methodologies used will generally be determined by the research paradigm or how the researcher perceives things related to the study context. In this study, the research method used to validate the framework is through expert review studies. We assumed a framework validation should be conducted in looking into the need to explore and further comprehend the developed conceptual framework. It will uncover the framework limitations or ambiguities that the literature study does not comprehend [37].

A. Validation Study with Expert Review

The validation study was conducted in the form of an online focus group discussion. The focus group discussion is designed to get collective feedback on the developed framework and plan the future work for developing the AR application. We introduced the framework by explaining the background of the framework, its purpose, the development process, the components, and their relationship at the beginning of the discussion. Then, during the discussion, we asked four questions. The questions are:

- Do you think the framework is comprehensive?
- Do you agree with all the components in the framework?
- Do you find any confusing components in the framework?
- Do you have any comments to improve the framework?

B. The Participants and Discussion Design

The focus group discussion was participated by six experts. The six experts have decided to follow the minimum of five experts suggested in the heuristics study's guideline for finding average problems [38]. The experts were identified based on their research work and activities as well as their years of experience in user experiences, serious games, and persuasive computing. The demographic of the experts is presented in Table IV. These experts had agreed to participate in the study.

The discussion session was conducted via online meeting. These six experts were first invited via email, asking for their participation and valuable input in the study. When all invited participants consented to participate, all meeting information and survey materials were forwarded to the participants. During the discussion session, experts were briefed beforehand. After the briefing, the session starts with the framework explanation, followed by the question-and-answer session. In the question-and-answer session, the moderator will ask a question, and participants will take turns giving their valuable insight. The online meeting was recorded, lasting about one and a half hours.

TABLE IV. PARTICIPANT DEMOGRAPHIC

Demographic	No
Gender	
Female	4
Male	2
Age	
30 - 34	1
35 - 40	1
41 - 45	4
Employment Status	
Academician	4
Researcher	2
Field of Expertise	
User experiences	2
Serious games	3
Persuasive Computing	1
Years of experience in the field	
5 - 9	3
Ten and Above	3

V. DISCUSSION

A. Result and Findings

Based on the discussion, we present the results and analyze them based on the questions during the discussion. The first question gauged the comprehensiveness of the proposed framework. The experts agreed that the components related to interactive learning have a direct effect on the digital storytelling application. Although, some comments are worth to be considered for further improvement. The synchronization of component plot and characters is a noteworthy point. When designing digital storytelling, it is important to ensure that the character's design and implementation are suitable to the story's context. As a result, the impact on interactive learning may be observed more clearly. Two experts discovered that the settings component has little effect on the digital storytelling parts. However, the other experts contended the setting is needed to differentiate the stories and their environment. Thus, the setting component remains in the framework.

The discussion also revolved around the issues of improving the learning outcome. However, it was explained that the issue is not the main objective of the framework. It is part of the learning process that should be considered in future work. Therefore, all experts mutually agreed that based on the given input, the scope of the study, and their expertise in the field, the framework and its constituents are likely to be deemed comprehensive.

The second question concerns consensus on the framework's components. This question was posed as a follow-up to the previous one. The purpose of this question was to ensure that the components were well-considered. After the discussion, the experts generally agreed on all the components. In response to the third question, none of the experts mentioned any concerns that would suggest a problem

with the components. After further explanation, the experts remark on their understanding of the study context.

The discussion for the final topic revolves around remarks and suggestions for further improvement. Apart from what has already been stated, the experts are more interested in the framework's implementation, notably the application design and evaluation strategy. It would be beneficial if the findings were presented in separate sessions.

B. Refind Framework

According to the expert interviews, the framework was devoid of Dementia-related features. As a result, the Dementia parts were included in the framework as shown in Fig. 5. To make each session more pronounced, the title will be included. Furthermore, significant sections between each framework session may be tightly associated.

Based on the expert interview comments, the following adjustments were made to the proposed model:

- Add framework sections- Information: The five key messages of Dementia friends which involved with 1) Dementia is not a natural part of ageing, 2) Dementia is caused by diseases of the brain, 3) Dementia is not just about losing your memory, 4) It is

possible to live well with Dementia, 5) There is more to the person than the Dementia.

These five fundamental messages are a starting point for understanding Dementia [39]. It is a critical step toward understanding Dementia. The five significant messages were reviewed and turned into a game called Teatime. The game's intended audience is the family of patients in the early stages of Dementia. The game symbolizes a possible Dementia symptom. However, another interactive platform to comprehend Dementia for youngsters will need to be created [39].

- Add a title to each section;
- System: Interactive Learning Setting Platform
- Platform: Digital storytelling Delivery Information: The key message of Dementia friends.
- Links were added to each session;
- System Applied Platform. Use the interactive learning system to apply to the digital storytelling platform.
- Platform Deliver Information. For the user to receive the information to increase their knowledge.

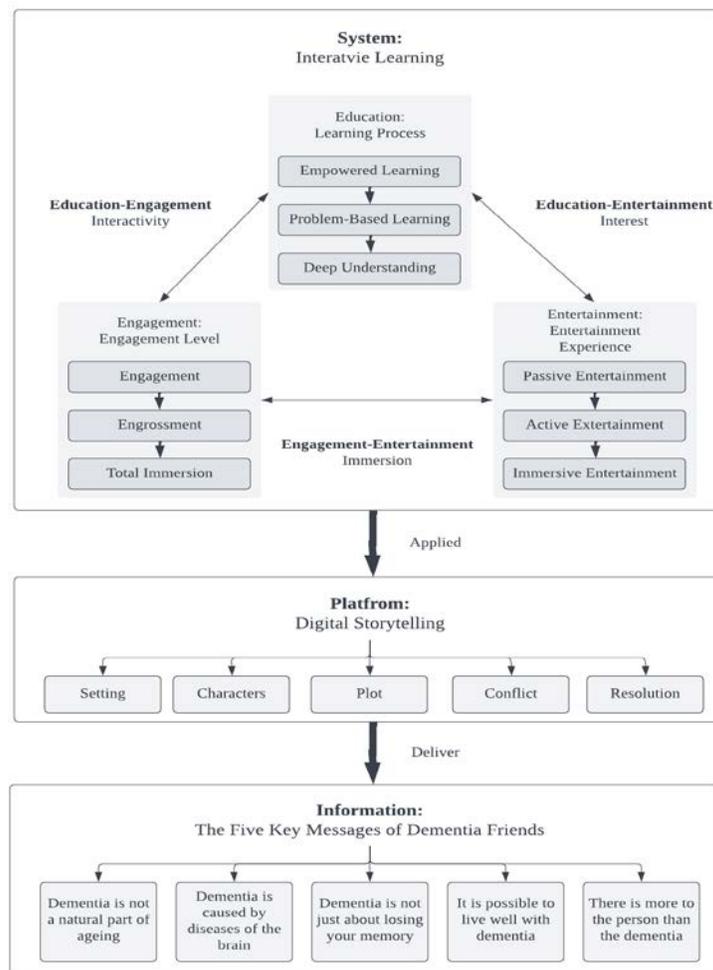


Fig. 5. Refined Conceptual Framework.

VI. CONCLUSION

In general, having a digital storybook can help young children interact with and sustain relationships with their grandparents. This study proposes a framework for a Dementia digital storybook for young children to assist them in comprehending their grandparents' condition. The framework was developed after an examination of applications and a review of the literature. The system featured two key interconnected components: an interactive learning environment and digital storybook elements. The framework's relevant components have been synthesized, and an expert review study has verified it. As a result, while considering the specific application for a Dementia digital storybook, these elements are seen as critical. This study contributes a new guideline for the designer and developer of a Dementia-related application to increase children's comprehension.

A prototype of a Dementia digital storybook for youngsters will be built for future development. This prototype will be evaluated with a range of users, including youngsters and family members with Dementia. The testing findings will eventually be used to prove the framework's validity. Overall, this approach is a useful resource for creating interactive learning aids to understand Dementia better. As part of the current study, children may learn about many long-term diseases (such as [16]) using a digital narrative framework.

The conceptual framework may be expanded with extensive knowledge about Dementia or substituted for various issues, particularly during an informative session. As a result, this research may be broadened to analyze how individuals become more aware of social concerns such as human rights, gender equality, and global warming.

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