# Effectiveness Enhancement for Science Communication using Short Animation Videos

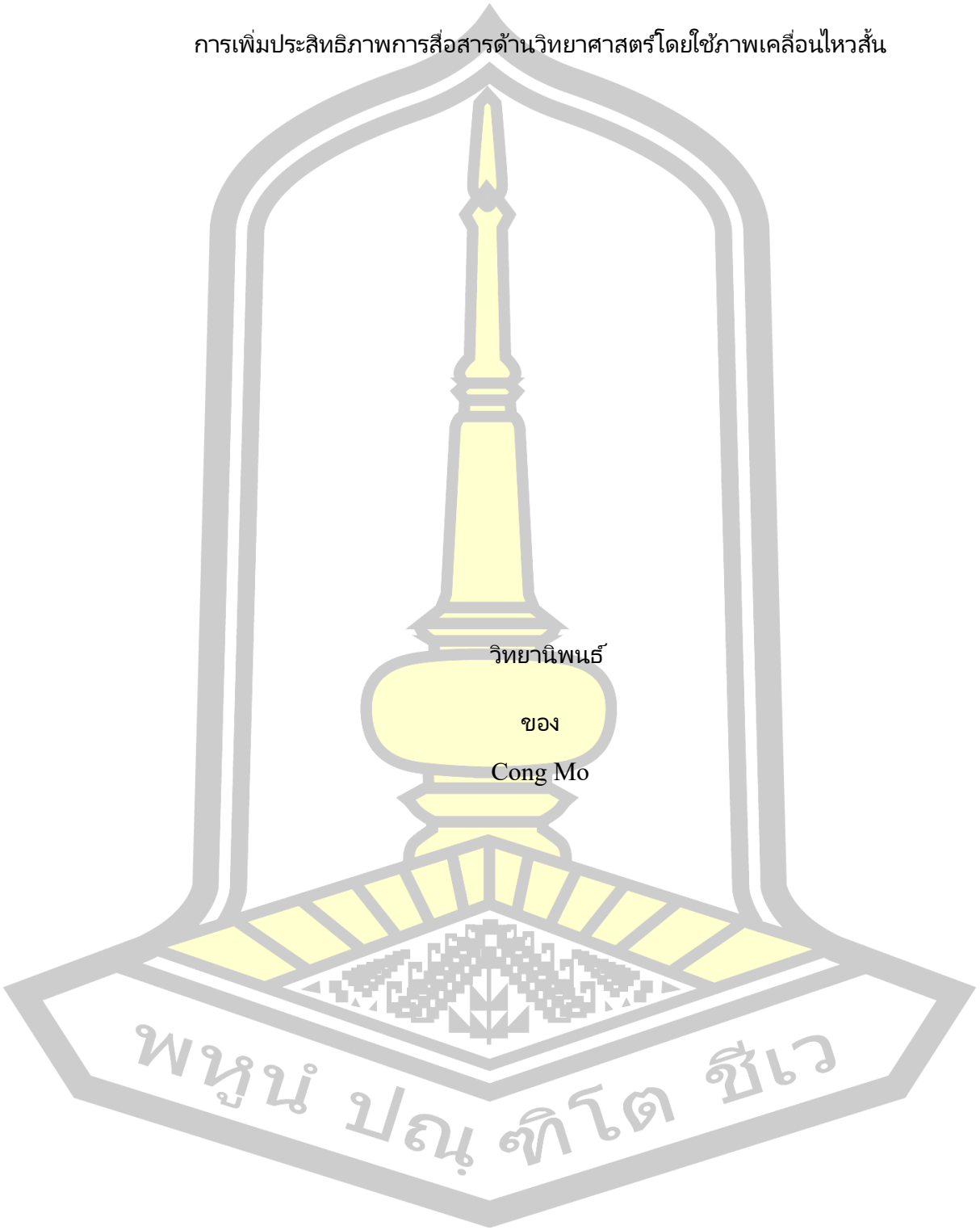
Cong Mo

A Thesis Submitted in Partial Fulfillment of Requirements for

degree of Doctor of Philosophy in Creative Media

June 2025

# การเพิ่มประสิทธิภาพการสื่อสารด้านวิทยาศาสตร์โดยใช้ภาพเคลื่อนไหวสั้น



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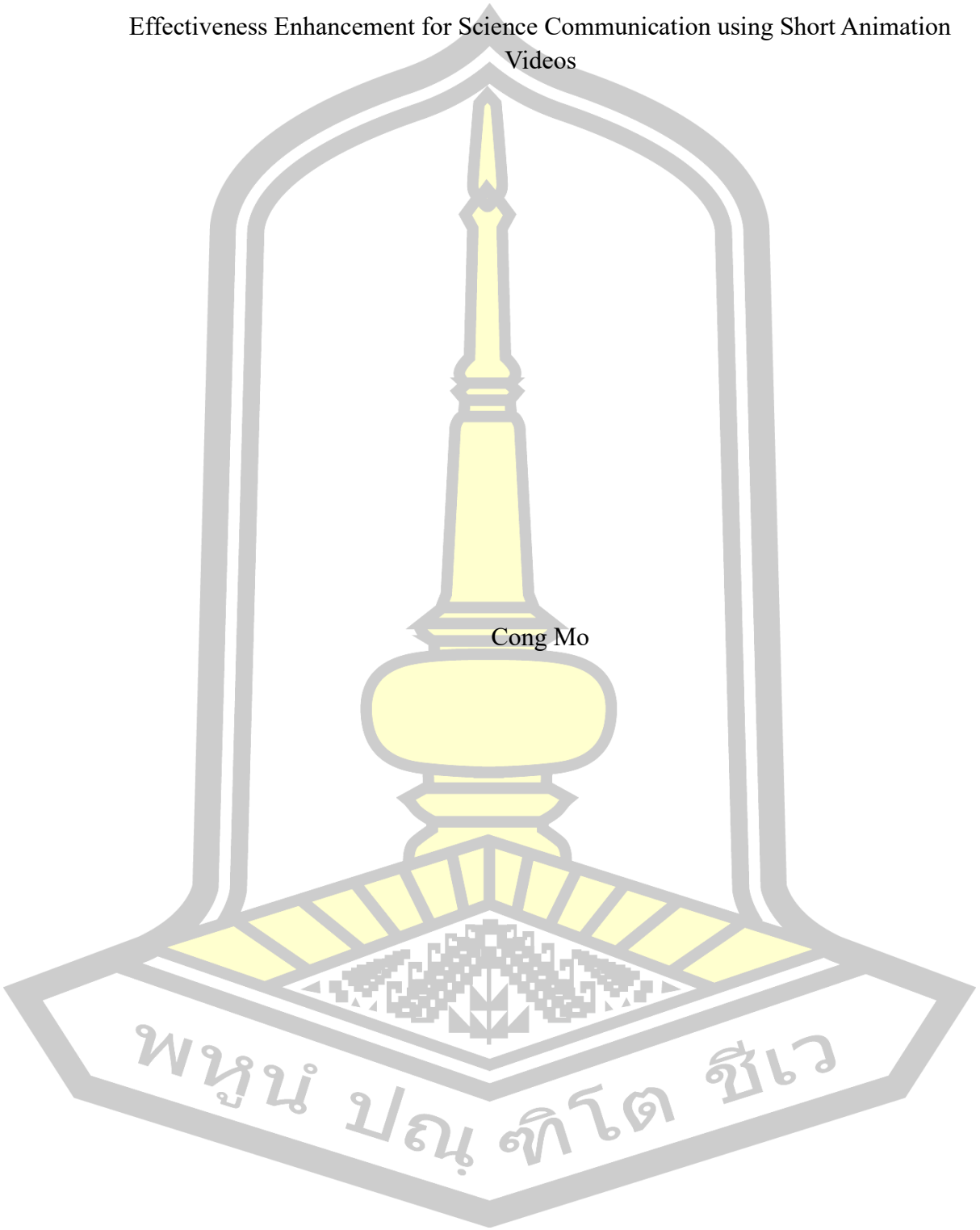

A Thesis Submitted in Partial Fulfillment of Requirements

for Doctor of Philosophy (Creative Media)

June 2025

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**TITLE** Effectiveness Enhancement for Science Communication using Short Animation Videos

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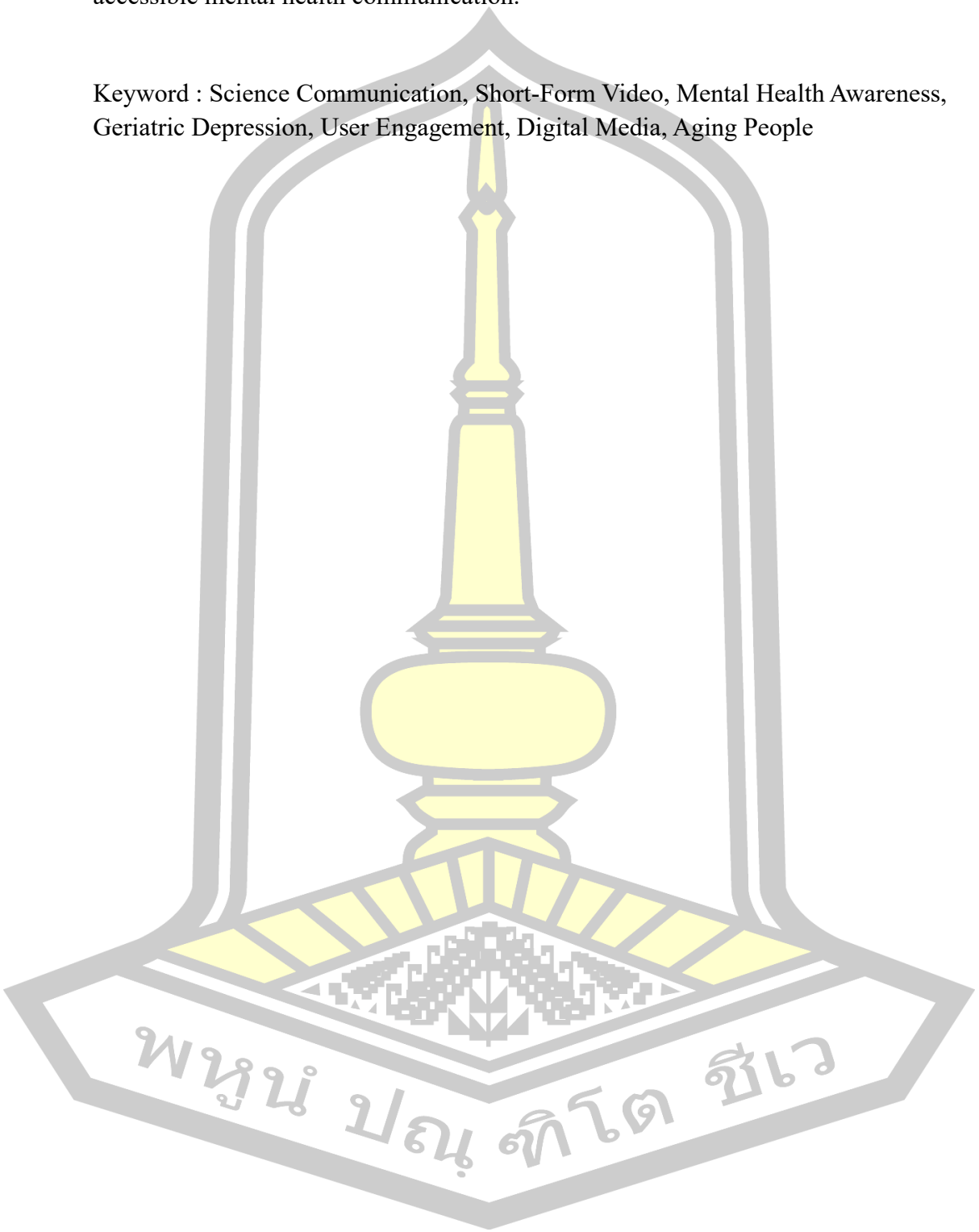
## ABSTRACT

Effective science communication plays a crucial role in raising public awareness of mental health issues, particularly among aging populations. This study explores the design and development of short-form science communication videos to enhance engagement and knowledge retention regarding geriatric depression. The research seeks to answer the question: How can short videos be designed and developed to effectively communicate scientific knowledge about mental health, with a specific focus on depression? A mixed-methods approach was adopted, integrating both quantitative and qualitative methodologies to assess audience engagement, comprehension, and behavioral impact. The research follows a structured four-phase framework. In Phase 1, web scraping and clustering techniques were applied to analyze online discussions, identifying key factors influencing user engagement. Phase 2 focused on storytelling, incorporating multimedia learning principles and emotional design to craft engaging and informative narratives. Phase 3 involved video production and strategic distribution on TikTok, where audience engagement was measured through interaction metrics such as views, likes, comments, and shares. Phase 4 assessed the effectiveness of the videos using pre- and post-test surveys, in-depth interviews, and expert evaluations utilizing the GQS and DISCERN scales. Findings indicate that emotionally compelling storytelling, visually engaging animations, and clear, structured content significantly enhance viewer engagement and comprehension. Statistical analyses demonstrate marked improvements in user trust, emotional resonance, and interactive behavior, while expert assessments confirm the credibility and clarity of the content. The results highlight the potential of short-form digital media as an effective tool for science communication, offering valuable insights into optimizing content for public health education and digital engagement. This study

underscores the growing significance of digital platforms in delivering impactful and accessible mental health communication.

Keyword : Science Communication, Short-Form Video, Mental Health Awareness, Geriatric Depression, User Engagement, Digital Media, Aging People



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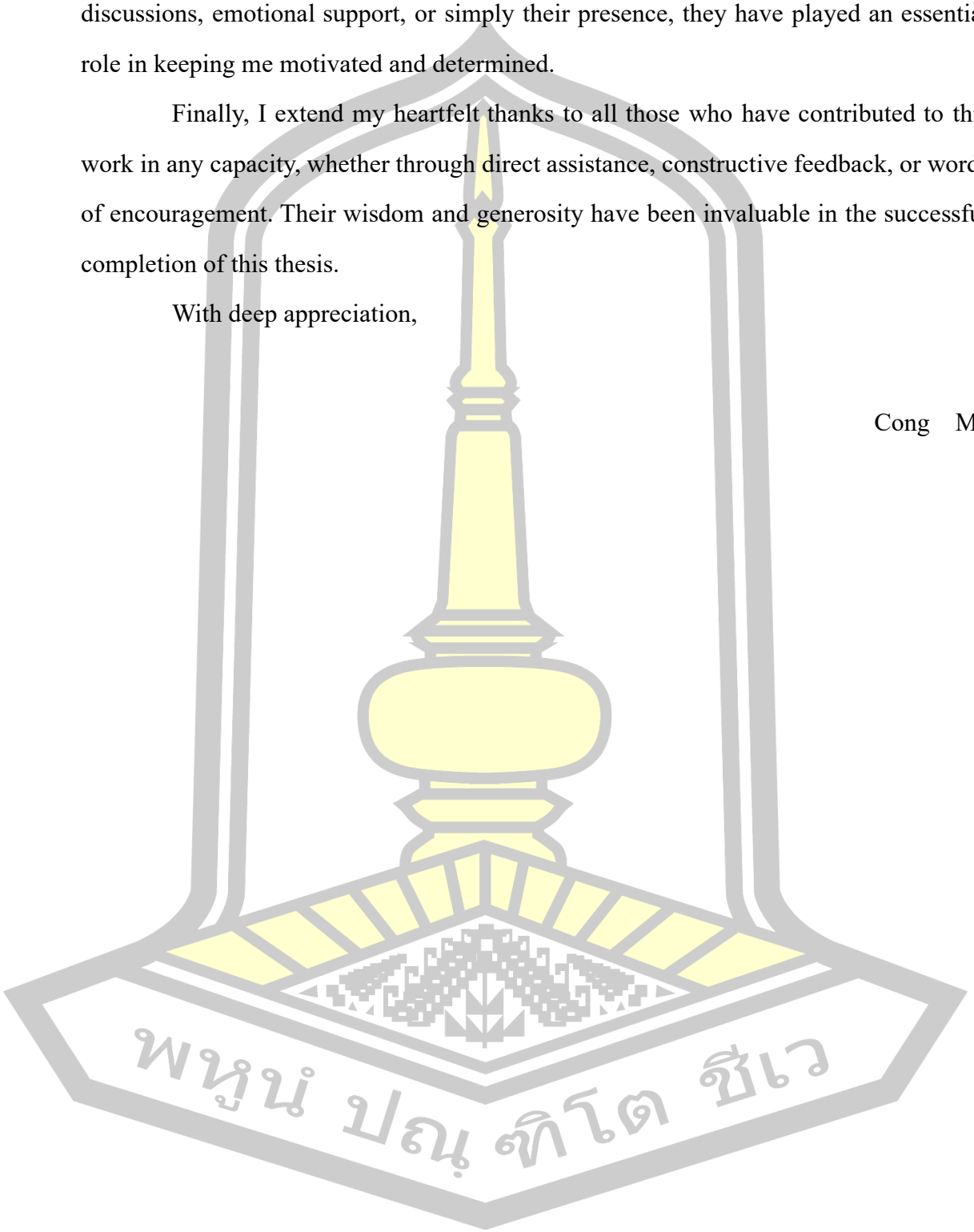

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# Chapter 1

# Introduction

## 1.1 Background

Science communication is the process of conveying scientific information, concepts, and discoveries to a wide audience in a clear, accessible, and engaging manner [1]. It involves translating complex scientific ideas and research findings into language and formats that the general public, policymakers, media, and other non-experts can understand and appreciate [2]. The objective of science communication is to establish a connection between the scientific community and the general public, with the aim of enhancing comprehension and recognition of scientific progress, concepts, and their consequences. The act of effectively communicating scientific information serves multiple purposes, including enabling the public to make well-informed choices, fostering a wider enthusiasm for scientific knowledge, stimulating critical thinking skills, and bolstering decision-making processes that are grounded in empirical evidence [3].

To the best of our knowledge, science communication can be a challenging task, since it involves various complications and obstacles in efficiently transmitting scientific knowledge to a wide range of people [4]. This is due to the fact that it can be complex and difficult to describe in simple terms, especially when dealing with advanced themes, and many people have minimal scientific experience, making it difficult to transmit information without overwhelming or confounding them. Bridging the scientific literacy gap necessitates skilled communication. Furthermore, scientists frequently utilize technical vocabulary and jargon that the general public may not understand. Avoiding jargon and translating technical terminology into simple, accessible terms necessitates significant thought. Simplifying scientific concepts can lead to oversimplification, which can lead to misunderstandings or disinformation. It is critical to strike the correct balance between simplicity and accuracy.

Science communication can take various forms [5], i.e. media, public talks and lectures, science journalism, social media, educational outreach, infographics and visualizations, public engagement, and science museums and exhibitions, and so on.

With the growth of social media real life connections, "Short Media" is a platform that has been established in the last decade [6]. Examples of short media platforms could include TikTok, Instagram, Twitter, YouTube Shorts, Snapchat, LinkedIn, Facebook Stories, Animated GIFs, and so on. Today, these platforms may be highly effective for science communication due to their ability to capture attention quickly and convey information in a concise and engaging manner. However, when using short media platforms for science communication, it is essential to keep the intended audience in mind, to emphasize the central message, and to make the content visually enticing and engaging [7]. The brief format encourages creativity and innovation in presenting complex scientific information in a way that captures the audience's interest and piques their curiosity. Today, there appears to be a dearth of extensive research and studies on the use of short media platforms for science

communication. Meanwhile, many scientists and organizations have started leveraging these platforms to engage audiences and distribute scientific information. More research into the effectiveness, impact, and best practices for science communication may be conducted as these platforms grow more prominent and engrained in modern communication practices.

Indeed, within the field of short media for science communication, "short videos" can be a powerful and successful answer [8]. Short movies on platforms like TikTok, Instagram Reels, and YouTube Shorts have various advantages when it comes to delivering scientific knowledge. Short videos are very engaging and have the ability to instantly capture viewers' attention, boosting the likelihood that your message will be heard and comprehended. It is also presented visually, with animations, demonstrations, and visuals, which can assist simplify complicated concepts and make them more accessible to a wider audience [9]. Short videos are ideal for demonstrating simple scientific experiments or demonstrations that bring concepts to life and encourage hands-on learning [10]. As a result, short videos can be used to present succinct, fascinating stories about scientific discoveries, the adventures of researchers, or the societal consequences of scientific developments [11]. These platforms are readily digestible, appealing to audiences with shorter attention spans or limited time for content consumption, and they are highly shareable on social media platforms, allowing your material to reach a larger audience through likes, shares, and reposts. Therefore, many social media platforms prioritize short video material, increasing its likelihood of appearing in users' feeds and explore sections, and they provide as a blank canvas for science communicators to experiment with new styles, formats, and tactics to engage their audience.

As previously mentioned, it can be challenging to apply short videos as an effective short media platform for science communication in this study, even if they may be able to explain scientific ideas and discoveries in a way that draws viewers in and entices them to learn more. Especially, this study specifically focuses on the communication of scientific information regarding mental health, namely depression.

## 1.2 Research Question

How can short videos be designed and developed to effectively communicate scientific knowledge about mental health, with a specific focus on depression?

## 1.3 Objectives of Research

1.3.1 The aim of this work is to provide a methodology for designing and developing short videos for effective science communication related to mental health knowledge (i.e. depression).

1.3.2 The target audience consists of aging individuals.

1.3.3 The proposed short video content will be showcased on the TikTok platform.

## 1.4 Scope of Research

1.4.1 The purpose of this study is to develop and evaluate a method for designing short videos aimed at improving the effectiveness of science communication, with a focus on mental health—specifically, depression.

1.4.2 The scientific communication content focuses on evidence-based information about depression, covering its causes, symptoms, treatment, and prevention. The target audience is aging people, who are at higher risk of geriatric depression. This group is selected due to both their vulnerability to mental health issues and their increasing use of digital media for health information.

1.4.3 The study utilizes three main datasets:

(1) Scientific mental health content, primarily concerning depression, extracted from reputable sources such as PubMed and certified hospital or health organization websites.

(2) Video content developed based on the extracted information, transformed into engaging short videos using storytelling, multimedia elements, and animation techniques.

(3) User feedback and interaction data, collected via questionnaires and TikTok analytics, including views, likes, comments, and sentiment from viewers within the target audience.

1.4.4 The research framework consists of four main phases:

(1) Data Collection: Relevant content is gathered using web scraping techniques to identify public interests and trustworthy health information.

(2) Content Extraction and Validation: Important information is filtered and organized using text processing methods. Domain experts are involved in verifying the scientific accuracy of the conte

(3) Video Design and Development: Based on Information Design Theory and Multimedia Learning Theory, content is transformed into compelling video scripts and produced as short-form videos suitable for the TikTok platform.

(4) Evaluation: The effectiveness of the videos is evaluated through quantitative and qualitative methods, including pre- and post-surveys, TikTok analytics, and expert reviews using GQS and DISCERN scales.

1.4.5 Evaluation covers three key aspects:

(1) Content accuracy and credibility, verified through expert reviews.

(2) User engagement metrics (e.g., views, likes, shares, comments) tracked via TikTok's analytics dashboard.

(3) Sentiment analysis, conducted on user comments to determine public perception and emotional impact of the videos.

## 1.5 Research Significance

The use of short videos for science communication about depression is a powerful tool for education, engagement, and advocacy. It leverages the strengths of visual media to break down barriers, spread knowledge, and foster a more informed and empathetic public discourse around mental health. Here are some crucial aspects emphasizing the significance of this communication strategy:

(1) Accessibility and Reach: Short videos facilitate the communication of scientific knowledge on depression to a broader audience. They may be readily communicated across many social media platforms, reaching those who may not actively seek out this knowledge via conventional routes such as scholarly journals or books.

(2) Engagement and Retention: Visual content, especially when concise and well-produced, tends to engage viewers more effectively than text-based content. This

increased engagement can lead to better retention of information, which is crucial for understanding complex topics such as the causes, symptoms, and treatments of depression.

(3) Demystification and Education: Depression is often surrounded by stigma and misconceptions. Short videos that communicate scientific findings can help demystify the condition, educating the public about its biological underpinnings, the psychological factors involved, and the effectiveness of various treatment options. This knowledge can promote empathy and support for those affected.

(4) Promoting Mental Health Literacy: Science communication through short videos can enhance mental health literacy among the general population. Understanding depression is the first step toward recognizing it in oneself or others, which can lead to timely intervention and support.

(5) Countering Misinformation: In an era where misinformation can spread rapidly online, authoritative and scientifically accurate short videos can serve as a counterbalance. They provide evidence-based information that can debunk myths and false claims about depression.

(6) Encouraging Open Conversations: By presenting information on depression in an accessible and engaging format, these videos can encourage viewers to start conversations about mental health, reducing stigma and isolation for those affected.

(7) Visual Storytelling and Empathy: Short videos have the unique advantage of combining visual storytelling with scientific communication. This can humanize the subject matter, making it easier for viewers to empathize with individuals experiencing depression, and fostering a more compassionate society.

(8) Adaptability to Audience Needs: Videos can be tailored to different audiences — ranging from children and teenagers to adults — by adjusting the complexity of the information, the language used, and the visual elements. This adaptability ensures that the content is relevant and understandable to each target group.

## 1.6 Terminologies

1.6.1 Science communication: Science communication mainly focuses on the concept of public understanding of science, and disseminates scientific knowledge, scientific methods, scientific ideas and the spirit of science to the public through certain forms of organization, channels and means of communication, in order to enhance the level of public scientific knowledge, technical skills and scientific literacy, and to promote the public's understanding of, support for and participation in science.

1.6.2 Short videos: Short videos refer to high-frequency pushed video content played on various new media platforms that are suitable for viewing in a mobile state and a short-time leisure state and are generally a few seconds to a few minutes in length.

1.6.3 New media: New media are media forms that appear under the new technology support system, such as digital magazines, digital radio, mobile TV, internet, digital TV, touch media, cell phone networks, etc.

1.6.4 Mental health knowledge: This encompasses a wide range of information, understanding, and awareness about mental health conditions, their prevalence, causes, symptoms, treatments, and the overall impact on individuals and society. It also involves recognizing the importance of mental well-being, the factors that can influence mental health, and the strategies for maintaining or improving it.

1.6.5 Depression: Mental health knowledge specifically about depression is crucial for recognizing, understanding, and effectively responding to this common but serious condition. Depression is more than just feeling sad or going through a temporary "down" period; it's a persistent problem that can significantly impact every aspect of an individual's life. Broadening mental health knowledge about depression can empower individuals to seek help early, support others, and contribute to a more understanding and compassionate society.

1.6.6 Science communication of depression using short videos: Short videos related to science communication of depression should aim to educate, reduce misconceptions, and promote positive attitudes toward seeking help.

# Chapter 2

# Literature Review

Effective science communication is crucial for increasing public awareness and understanding of complex topics, particularly in the field of mental health. However, traditional methods of delivering scientific knowledge often struggle to engage audiences due to issues such as information overload, technical jargon, and low public interest. With the rise of new media technologies, short videos on platforms like TikTok have emerged as powerful tools for science dissemination, offering an engaging, accessible, and interactive format. This chapter explores the theoretical foundations and related research that inform the design and development of short videos for science communication. Specifically, it reviews Information Design Theory and Multimedia Learning Theory, which provide essential guidelines for crafting effective and user-centered multimedia content. Additionally, recent studies on science communication through short videos are examined to highlight best practices and challenges in leveraging digital media for mental health education, particularly for aging populations.

## 2.1 Related Theorems, Algorithms, and Techniques

### 2.1.1 Information design theories

Information design theory is a theoretical framework for studying and analyzing how to effectively deliver information and content through new media platforms [12]. This theory delves into how to effectively deliver and present information in the digital age, with the core goal of optimizing the process of expressing, interacting with and receiving information through the use of new media technologies [13]. This theory is not only about aesthetic design, but also an interdisciplinary field of study involving theoretical and practical knowledge from a few disciplines such as communication, psychology, design, computer science, etc. It reflects the common concern of how to effectively design and deliver information in the context of the rapid development of new media technologies.

Therefore, information design theory was not developed by a single individual or at a specific moment in time. Rather, it is an interdisciplinary field that has evolved over time with contributions from experts and practitioners in multiple fields [14]. The development of information design theory is closely tied to advances in digital technology and the rise of social media. With the proliferation of the Internet, mobile devices, and social platforms, the way people access, share, and consume information has fundamentally changed, prompting designers, researchers, and technology developers to explore new design methodologies and interaction patterns to accommodate these changes [15]. As such, this theory is the result of multidisciplinary cross-collaboration, encompassing a wide range of expertise from user research and visual design to programming and content strategy. It continues to evolve, reflecting how new technologies, tools, and platforms affect the creation, distribution, and reception of information [16]. The main elements of the theory are:

1. User-centered design: This is a design process and philosophy that places the needs, preferences and context of the user at the center of the entire media communication design and development process. This approach emphasizes the consideration of the user experience at every stage of the design process to ensure that

the final product or service meets user needs, enhances the user experience and ultimately increases user satisfaction and loyalty [17]. This approach creates a cyclical, incremental process through continuous user research, design iterations, and user testing, as shown in figure 2.1:

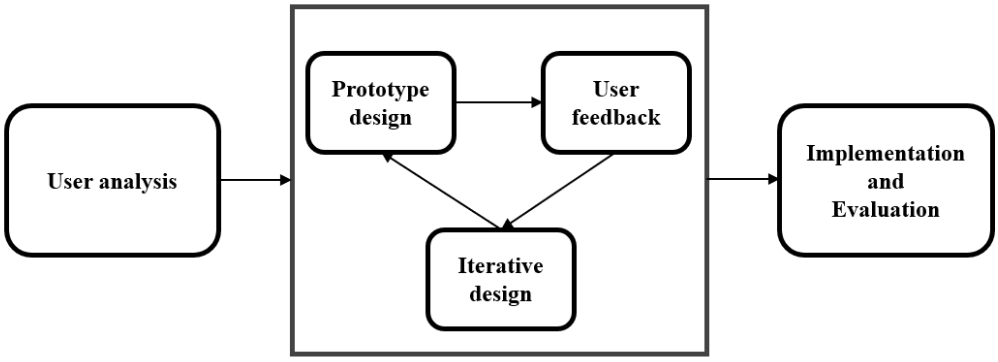



Figure 1 User-centered design process

Therefore, the benefits of using UCD for media message design are obvious:

(1) Increased user satisfaction: by meeting users' needs and expectations, the attractiveness of the product and user loyalty is increased.

(2) Reduced development costs: Identifying and solving problems early on can reduce the need for later modifications, thus reducing development costs.

(3) Enhance media readability: Focusing on the user experience improves media readability, enabling users to learn and accept new media messages more quickly.

(4) Promote innovation: The user-centered design process encourages innovative thinking and can result in unique solutions that meet untapped market needs.

2. Interactivity: New media information design emphasizes the interaction between the content and the user, including how the user can manipulate and provide feedback on the information content to enhance its appeal and retention [18]. This includes designing intuitive navigation systems for websites or applications, creating interactive charts or data visualization tools, and developing user-definable content filtering options.

3. Use of multimedia elements: Using multiple media forms, such as video, audio, images and text, to enhance the effectiveness of information delivery, this multimodal expression can help reach a wider audience and accommodate different user preferences [19]. For example, the development of new media learning platforms containing interactive video tutorials, charts and self-assessment quizzes to accommodate users with different learning styles.

4. Accessibility: Design to ensure that information can be accessed and understood by all potential users, including those with visual, hearing or other impairments. Adhere to the Web Content Accessibility Guidelines (WCAG), design images that include alternative text, captioned videos, and easy-to-read content layouts.

5. Usability and functionality: Information design should not only be aesthetically pleasing, but also practical, ensuring that users can easily find the information they need and that the design encourages specific user behaviors. This requires media publishers to conduct user testing to identify and improve usability issues in the design and to ensure that users can complete tasks efficiently.

6. Content strategy: Effective new media message design also includes strategic planning of the content itself, how it is organized, presented, and how to keep

it relevant and engaging. Examples include updating content regularly, using search engine optimization (SEO) techniques to improve visibility, and adjusting content based on user feedback.

7. Technological adaptability: With the rapid development of new media technology, new media information design theory also emphasizes that the design should be able to adapt to the ever-changing technological environment, including cross-platform design and responsive design [20]. For example, responsive design is used to ensure the compatibility of content on different devices, as well as utilizing the latest Web technologies (such as HTML5 and CSS3) to enhance user experience.

The application of the new media information design theory is found in a variety of fields, especially in today's highly advanced digitalization and Internet technologies. This theory influences how information can be effectively designed, communicated and managed through new media channels. The following is an overview of some of the key application areas:

(1) Social media platforms: use algorithms to personalize content recommendations for users while providing interactive features such as comments, shares and likes to increase user engagement.

(2) E-commerce sites: Enhance the shopping experience with high-quality product images, detailed product descriptions, user reviews and interactive shopping cart features.

(3) Online education: Develop online courses that include video lectures, interactive quizzes and community discussion forums to accommodate different learning styles and promote student interaction.

(4) Digital marketing and advertising: Design engaging ad content using multiple media formats such as video, images, text and audio, and leverage user behavioral data to optimize ad delivery and increase marketing effectiveness and returns.

These application areas demonstrate how new media information design theories can be flexibly applied to all aspects of creating, disseminating and managing information according to different needs and technological conditions, thus improving accessibility, comprehensibility and interactivity of information, and ultimately facilitating more effective communication and user engagement.

### 2.1.2 Multimedia Learning Theory

Multimedia Learning Theory is an educational theory proposed by Richard E. Mayer based on a series of experimental studies, which aims to explore how to improve learning by combining multiple media such as text, images, audio, and video [21]. This theory is based on the principles of cognitive psychology, especially the Cognitive Load Theory and the Dual Coding Theory of human information processing. Multimedia Learning Theory suggests that learning can be facilitated more effectively when material is presented in both visual and auditory form, as this makes better use of the brain's processing power [22]. Below are a few of the main components of multimedia learning theory:

(1) The two-channel hypothesis: Humans have two separate information processing systems: one for visual material (e.g., diagrams and text) and another for auditory material (e.g., spoken words and sound effects). This means that both visual and auditory information can be processed at the same time, thus increasing the total capacity for information processing [23].

(2) Finite Capacity Assumption: Each channel (visual and auditory) has a finite capacity for information processing. This means that only a certain amount of information can be processed efficiently at any given time [24]. Too much information leads to cognitive load, which reduces learning.

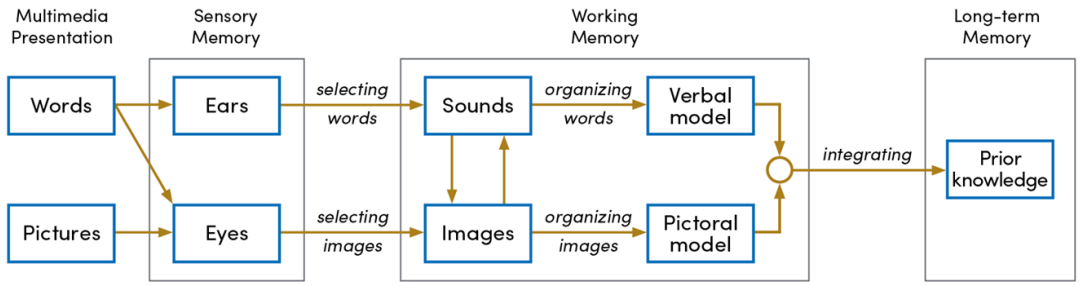



Figure 2 Two separate information processing systems

(3) Active Processing Hypothesis: Effective learning requires learners to process material mentally and actively. This includes selecting relevant information from a multimedia presentation, organizing that information into a coherent structure, and integrating that information with pre-existing knowledge structures [25].

At the same time, Meyer and his colleagues propose a series of design principles based on these assumptions that are intended to guide the creation of multimedia learning materials to optimize learning outcomes. These principles include [26]:

(1) Coherence Principle: Unnecessary materials such as extraneous background music or decorative images should be avoided as they may distract learners.

(2) Signaling Principle: The use of cues or highlighting can help direct learners' attention to important information.

(3) Redundancy Principle: In some cases, providing both written instructions and verbal explanations can lead to cognitive overload. Simplifying the way information is presented can help improve learning.

(4) Spatial Contiguity Principle: Relevant text and images should be presented in close spatial proximity to reduce the need for learners to shift their attention between visual elements.

(5) Temporal Contiguity Principle: Explanatory text and sound should be presented at the same time as the corresponding images or animations to improve learning efficiency.

(6) Segmenting Principle: Complex learning materials should be divided into smaller chunks to allow learners to learn at their own pace.

(7) Pre-training Principle: Pre-training learners on key concepts and terminology before complex multimedia learning can help reduce cognitive load.

(8) Personalization Principle: The use of conversational and informal language styles can increase the appeal and effectiveness of learning materials.

(9) Voice Principle: The use of the human voice, rather than mechanical voices, can increase the intimacy and effectiveness of learning.

Multimedia learning theory emphasizes that through rational design and organization of multimedia materials, unnecessary cognitive load can be effectively reduced, while taking advantage of human dual-channel information processing

capabilities, thus improving learning efficiency and memory [27]. These principles and assumptions have been widely applied in the fields of educational technology, online learning, and educational software development, through which educators and designers are able to create more dynamic, interactive, and personalized learning experiences.

## 2.2 Related Works

We know that science communication often faces some unique challenges and difficulties, including:

(1) Understandability of specialized terminology: Scientific fields often contain specialized and technical terms that may be difficult for the general public to understand. Science communication needs to find appropriate ways to explain complex concepts to make them more understandable to non-specialists.

(2) Communication distortion: Information is prone to distortion during communication and scientific content may be misinterpreted or misinterpreted. Science communication needs to work to minimize misunderstandings and help the public understand scientific concepts more accurately.

(3) Uncertainty in scientific research: Scientific research is often accompanied by uncertainty, and the public may prefer to receive information that is certain. Dissemination of uncertain scientific findings may trigger misunderstanding or panic and needs to be handled with care.

(4) Information overload: In an age of information explosion, the public may face information overload and find it difficult to discern what information is reliable and accurate. Science communication needs to stand out in a competitive information environment.

(5) Asymmetry of interest: The public may show low interest in certain scientific topics, even though these topics may have a significant impact on society. Science communication needs to find ways to generate public interest in these important but less visible topics.

(6) Balance between science and entertainment: In order to attract public attention, science communication sometimes needs to be combined with entertainment elements. However, this can also lead to exaggeration or distortion of scientific information.

Clearly, these issues are serious constraints to the effective dissemination of scientific knowledge.

However, with the arrival of the new media era, there are possibilities and ways to solve the above problems. New media has many advantages in communication, making information spread more quickly and widely, and also has many advantages such as real-time, interactivity, personalization, convenience and low cost, so it is logical to use these advantages of new media to solve the problems encountered in scientific communication. As a new member of the new media era, the advantages of short video are self-evident. The advantages of delivering information in a short period of time, social sharing, creativity and entertainment, rapid dissemination of social attention, and adaptation to the mobile terminal [28], which are not available in other forms of new media, have made the research on the use of short videos to solve the difficult problems in science communication more and more, attracting more and more attention, and becoming a popular research in the related fields in recent years.

Therefore, after studying the relevant literature in the past five years using the literature research method, it is found that many studies have focused on how to utilize the advantages of the new media short video itself to solve the obstacles and related problems in science communication. Some of the more representative studies are presented here as examples:

Xiong et al. [29] summarized some practical problems encountered in meteorological popularization, such as dry and specialized content (for the general public) and the lack of understanding of the operation of short-video content due to the fact that it is only a forced transfer of traditional text-based popularization of science presented on short-video, and the lack of effective dissemination techniques for related terms and content that may cause cognitive barriers. The advantages of short video platforms are also pointed out, such as a wide range of target groups, policy support from the short video platform itself, and strong communication timeliness. Finally, corresponding dissemination strategies are proposed, such as making appropriate modifications to the popular science content from the perspective of ordinary users to facilitate dissemination; hiring professionals to assess and evaluate the short videos; and emphasizing interactive communication to strengthen interactive discussions on meteorological knowledge.

Chen et al. [30] used content analysis and regression analysis to analyze 719 short videos posted by 23 "excellent popular science journals" in China, and pointed out that eight factors, such as content theme, narrative style, title length, cover type, background music, comments and interactions, the number of fans, and the frequency of updates, have a significant effect on the dissemination effect of short videos posted by popular science journals on Jieyin, while the relationship between short video duration and the dissemination effect of short videos on Jieyin is not significant. It was pointed out that eight factors, such as content theme, narrative style, title length, cover type, background type, comment interaction, number of fans, update frequency, etc., had a significant effect on the dissemination effect of science popularization journals' short videos on Shakeology, and the relationship between short video length and the dissemination effect of short videos on Shakeology was not significant. Meanwhile, popular science short videos should choose content themes related to the audience's life and adopt a light and humorous narrative; add background music and use "picture + text" cover to trigger emotional resonance and create "first look effect"; set up a professional team to improve the frequency of updating short videos, and actively respond to the short videos. We set up a professional team to increase the frequency of short video updates and actively respond to audience comments.

Chen et al. [31] Starting from a comparative study of long and short videos, the study explores the factors influencing the effects of long and short videos in science communication. The study constructed a theoretical model from two aspects, center path and edge path, respectively, and empirically examined selected videos on B station using regression analysis. The paper found that factors such as content theme, account authentication, title sentence style, video type and narration style have differential effects on the communication effect of long and short videos, while factors such as content source and background music have no significant effect on the communication effect. Finally, the authors put forward some suggestions for science communication based on the findings, such as collaborative creation, well-conceived titles, and optimization of sound and picture combinations.

Zhang et al. [32] mainly discuss the production of short video science content from the perspective of brand image construction. The study adopts the content analysis method to interpret the released short videos from the aspects of theme, picture and effect, summarize the types of brand image it constructs, and propose optimization strategies. That is, to optimize the brand image self-construction of short videos, it is necessary to refine the brand qualities, show multiple images, make good use of narrative techniques, optimize the video content, and enhance user stickiness.

Qin et al. [33] in this project is the use of short films to improve education in the post epidemic era. The paper suggests the advantages of using short films as a teaching tool, including their brevity, insightfulness, visual and neurological features, and their ability to transcend linguistic and spatial constraints. The thesis suggests the use of a flipped classroom model in which students watch short films before class and then discuss, simulate, or experiment with them in class in order to increase student initiative and interaction. The thesis discusses the problems that may be encountered in implementing short films for teaching and learning, including student and instructor resistance, lack of technology and resources, and web accessibility and quality, and proposes some solutions.

Liu et al. [34] used 63 accounts of elderly doctors (over 60 years old and up to 92 years old) on the ShakeMe platform in February 2021 as a sample to explore the driving mechanism of account influence of elderly doctors posting health science videos on the ShakeMe platform based on five characteristics of the social system and the technological system (tumor-related attributes, public attributes, comment interactions, sensibility, and video collection), and used the fuzzy set qualitative comparative analysis (fsQCA) method to analyze the impact of different configurations of social and technical systems on account influence. The study found two configuration paths leading to strong influence: public attributes + video collection, and tumor-related attributes + comment interaction + sensibility. The paper reveals the complex causal relationship of the influence of health science accounts on the Jitterbug platform, provides reference suggestions for improving account influence, and offers new perspectives on the application of socio-technical systems theory and configuration methods.

A study by Zawacki E et al. [35] examines whether TikTok is an effective platform for earth science communication. The paper notes that there is a lot of educational content on TikTok, including science, history, and art, and that it provides high-quality learning materials by collaborating with experts from all walks of life. In STEM fields, chemistry and physics experiments are the most popular content, while earth science is relatively lacking. In order to increase the visibility of earth science on TikTok, as well as to explore the best distribution strategies, the authors created an account called Terra Explore and posted 48 earth science educational videos. After operating and managing the account for a certain period of time, it was concluded from the final data analysis that there is a relationship between the number of views of the videos and the time of posting, with videos posted in the morning or in the afternoon being more likely to receive more views. There is also a relationship between the number of views and the date of release, the average number of views of videos released on Monday is the highest, and the average number of views of videos released on Wednesday and Thursday is the lowest. There is no significant correlation between the number of views and the length of the video, but videos that are too short or too long

are less likely to be viewed in their entirety. There was also a strong correlation between video views and video content, with videos related to recent news events (e.g., earthquakes) or the geology of a specific location being more popular. The authors conclude by suggesting that TikTok is a promising platform for geoscience communication that can engage and influence a wide audience. In order to increase video views and interaction, geoscience communicators should pay attention to the following: choose topics related to current events or locations, use interesting and vivid visuals, control video length and posting time, use appropriate titles and hashtags, interact with and promote other social media accounts, and experiment with different video styles and formats.

Zhu et al. [36] analyzed the presence or absence of official Tik Tok accounts in 31 provincial health committees in China, from which the 100 most popular micro-videos were selected, coded and counted on three dimensions: quantitative impact, video content and video format. The study found that there were more cartoon and documentary types of micro-videos, the topics were mostly related to the image of health professionals and knowledge of diseases, there was a high percentage of using original music, Mandarin and subtitles, and the video length was usually less than 60 seconds. The paper points out that health departments face problems such as insufficient followers, low interactivity, and uneven content quality when using Tik Tok for health communication, and suggests that health departments should strengthen their account promotion, content innovation, and interaction strategies to improve the attractiveness and influence of microvideos.

Radin Abigail et al. [37] describe how TikTok was used as an innovative instructional strategy to model and teach effective science communication in a course-based undergraduate research experience (CURE) course, and share steps and criteria for creating and evaluating TikTok videos, as well as considerations and challenges. The paper argues that using TikTok can help students practice science communication skills in a relevant and fun way while also contributing to science popularization.

Chen et al. [38] researched 82 domestic hospitals official Jieyin accounts with more than 10,000 fans, analyzed the content, form and effect of their science popularization short videos, and found some existing problems, such as insufficient content richness, insufficient authority of the dissemination subject, and a single presentation method. Thus, suggestions are put forward to improve the communication effect of hospital science popularization short videos, such as scientifically setting up rich communication contents, focusing on cultivating authoritative communication subjects, and reasonably arranging the presentation mode of videos. The paper takes the existing ShakeYin account as a blueprint, conducts an in-depth textual analysis of its health science popularization short videos, and explores various factors affecting the communication effect of its short videos, such as the professionalism of the communicator, the excitement of the content, and the duration of the video.

Zenone et al. [39] used data from TikTok, a short-video social media platform, to proactively discover and understand conspiracy theories related to the emerging monkeypox outbreak so that public health departments can debunk them before they spread. The paper analyzed 153 videos containing monkeypox conspiracy theories or themes, categorizing them into 11 types. It concludes by noting that the high number of views and interactions with these videos illustrates the potential for the prevalence and spread of monkeypox conspiracy theories, and suggests that public health professionals

should pay more attention to and invest in monitoring the online environment, as well as responding to disinformation in a timely manner.

This paper by Thang et al. [40] is a comparative analysis of the content and quality of acne treatment information on three short-form video platforms: TikTok, Instagram Reels, and YouTube Shorts. The authors searched for videos related to "acne treatment" on the three platforms, screened 250 videos according to certain criteria, and then evaluated the quality and usability of the videos using the DISCERN tool and the Global Quality Score (GQS). The authors found that most of the videos on these platforms were produced by non-dermatologists, but the quality and usability of videos produced by dermatologists was significantly higher than that of other types of videos. The authors concluded that short-form video platforms are an opportunity for dermatologists to disseminate knowledge about acne treatment to the public, as these platforms are widely followed by adolescents with acne. The authors recommend that dermatologists produce more high-quality videos on these platforms to improve education and satisfaction among acne patients.

Wang et al. [41] assessed and analyzed the content and quality of stomach cancer-related videos on three of the more popular video-sharing platforms, Bilibili, TikTok, and YouTube, and their impact on the public in this innovative study. The authors screened 300 eligible stomach cancer-related videos from these three platforms and recorded their basic information, such as source, content type, duration, number of views, number of likes, and number of comments. Then, the Global Quality Scale (GQS), Journal of the American Medical Association (JAMA), and revised DISCERN tools were used to assess the educational content and quality of each video. Finally, videos from all three platforms were comparatively analyzed. In conclusion, this innovative study demonstrates that videos on social media platforms can help the public understand early signs, advanced symptoms, treatments, etiologic and causative factors, and scientific presentations of gastric cancer. However, the currently uploaded videos fall short in terms of content and quality. More efforts should be made to improve the content and quality of stomach cancer videos to increase public awareness.

Subramanyam et al. [42] analyzed popular dermatology-related videos on TikTok and the percentage of users with or without medical qualifications in these videos in the paper. The authors selected 20 hashtags for dermatologic conditions and procedures based on statistics on dermatologic diagnoses and procedures in the United States, searched TikTok, and watched the top 10 videos under each hashtag. Finally, the authors note that the majority of dermatology-related content on TikTok is created by individuals with no verifiable medical training, which provides an opportunity for board-certified dermatologists to demonstrate their specialty and prevent misinformation about health. This paper suggests adding certification for medical professionals on TikTok to increase their credibility and visibility.

### 2.3 Existing Method

There are a variety of ways to use short videos for science communication, and creators and science organizations have tried many strategies to engage viewers and communicate science effectively. Below are some examples of applications that already exist for utilizing short videos for science communication:

Storytelling: Utilize the power of storytelling to engage your audience. Even complex scientific concepts can be brought to life through storytelling. Stories can help

the audience make an emotional connection, thus increasing the appeal and memorability of the information.

Visualize complex concepts: Use graphs, charts, animations or images to explain complex scientific concepts. Visual elements can help viewers better understand and remember information, especially abstract concepts that are difficult to describe in words.

Interaction and participation: Encourage audience participation and interaction, for example by asking questions, directing viewers to share their opinions in the comments section, or conducting online polls. This engagement increases viewer motivation and attention to the content.

Use emotion and humor: Adding an element of humor or an emotional component where appropriate can humanize science communication and increase audience interest and engagement. Emotional connection is also an important factor in enhancing the effectiveness of information dissemination.

High-quality production: Focus on the production quality of the video, including clear visual effects, good audio quality and professional editing. High-quality production can enhance the viewing experience of viewers and increase the credibility of the content.

## 2.4 Gaps and problems in current research

To summarize, short video, as a new medium for disseminating information, does have great potential worth studying, but there are still some challenges and shortcomings in the current research in the field of science communication.

First of all, current related research is quantitatively more oriented towards theory than practical application. This is contrary to a practice-oriented field such as science communication. Many current studies are mainly based on the traditional theories of communication, but there is a lack of research on new media such as short videos, mobile terminals, and user interactions, which make it possible to look forward to the possibility of solving problems that could not be solved in the past.

Secondly, according to the current literature, there is almost no research on the scientific and authoritative nature of science popularization short videos, which is in a research gap. Especially in China, the number of Internet users is huge, and the gap in knowledge level is large, which makes it easy to spread rumors and disinformation on a large scale, or even the so-called "want to disinformation instead of rumor", resulting in the loss of credibility of scientific communication, and making the dissemination of scientific knowledge even more difficult. Therefore, it is necessary to study how to audit the content of popular science short videos, how to set up access conditions, and how to prevent the uncontrolled spread of rumors and pseudoscience.

Finally, current research lacks studies on new media operation of popular science accounts on short video platforms. How to understand the needs of users, how to improve the traffic flow for the operation mechanism of the short video platform itself, and how to look at the current algorithm-based recommendation of short video platforms leading to the traffic-oriented content production concepts of some creators.

## 2.5 Web Scraping

Web scraping [43] is the process of using software or scripts to automatically extract information from websites. This technique involves sending HTTP requests to web servers, retrieving HTML or structured data (such as JSON or XML), and parsing

the content to extract relevant information. The collected data can then be stored in a structured format, such as a database or spreadsheet, for further analysis or application.

Web scraping is widely utilized across various domains, including data analysis, sentiment analysis, and content aggregation. It enables the extraction of text, images, and links from web pages, making it an essential tool for collecting information at scale. Some common applications include monitoring product prices, gathering customer reviews, tracking market trends, and compiling datasets for research purposes.

In this study, Scrapy, a Python-based web scraping framework, was employed to facilitate data extraction. Scrapy is particularly well-suited for large-scale scraping tasks due to its speed, scalability, and ability to manage complex website structures efficiently. It provides robust functionalities for handling web requests, parsing HTML elements, and exporting extracted data in various formats, ensuring an organized and structured dataset for further processing.

By leveraging Scrapy, this research effectively automated the collection of relevant web content, streamlining the data acquisition process and enhancing the accuracy and efficiency of the study.

Example: Web Scraping for Short Video Design in Science Communication on Mental Health for Aging People

To design short videos for science communication related to mental health knowledge for aging people, researchers need reliable and diverse sources of information. Web scraping can be applied to collect relevant data from sources such as:

- Scientific articles and research papers from databases like PubMed, Google Scholar, and university repositories.
- Health-related websites such as WHO (World Health Organization), CDC (Centers for Disease Control and Prevention), and mental health organizations.
- Social media discussions and reviews from platforms like Twitter, Reddit, and Facebook, where aging individuals or caregivers discuss mental health challenges.
- Video content and transcripts from YouTube, TED Talks, or educational platforms to analyze effective communication strategies.

A Scrapy-based crawler can be designed to extract structured information from mental health blogs, while Selenium can be used to scrape interactive content from video platforms. After gathering data, Natural Language Processing (NLP) techniques can help identify key themes, frequently discussed concerns, and effective communication styles for designing informative short videos tailored to aging populations.

This approach ensures that content creation is data-driven, scientifically accurate, and resonates with the target audience, enhancing the impact of mental health awareness campaigns.

## 2.6 Text Analysis using Clustering

This section follows a structured methodology to extract, process, and analyze textual data using web scraping, natural language processing (NLP) [44], and machine

learning techniques (i.e. K-means Clustering) [45]. The process is divided into four key steps:

***Step 1: Sentence Separation and Text Preprocessing*** [46]

After retrieving relevant English-language web pages through web scraping, the text is cleaned by removing extraneous elements such as HTML tags, scripts, and advertisements. Sentence separation is then applied to divide the text into meaningful units, improving clarity and facilitating NLP tasks.

Next, the text undergoes preprocessing, which includes tokenization (breaking text into words or sentences), lowercasing for uniformity, and the removal of stop words (e.g., is, the, and) to eliminate non-essential words. Additionally, stemming or lemmatization is applied to reduce words to their root forms, making the data more structured. Special characters, punctuation, and irrelevant numerical values are also removed. This systematic preprocessing ensures that the text is clean, organized, and ready for further analysis.

***Step 2: Text Vectorization using Term Frequency (TF)***

The cleaned and preprocessed text is transformed into numerical representations using Term Frequency (TF) [47]. This method calculates the frequency of words within each document, providing a structured representation of textual data. TF is particularly useful for k-means clustering, as it highlights frequently occurring terms, ensuring that similar documents are grouped together based on meaningful patterns.

$$TF(w,d) = \frac{freq(w,d)}{\sum_{w' \in d} freq(w',d)} \tag{2.1}$$

where $w$ is the specific term for which the frequency is being calculated. $d$ the document in which the term frequency is being measured. $freq(w, d)$ The raw frequency count of term w in document $d$, i.e., the number of times w appears in $d$. $\sum w' \in d$ $freq(w', d)$ is the total number of terms in document $d$.

A key advantage of TF is its ability to normalize word frequencies, preventing longer documents from dominating the clustering process. By structuring text data numerically, TF enables efficient computational processing and enhances the accuracy of document comparisons.

***Step 3: Clustering Relevant Texts using k-means***

Once the text is vectorized, k-means clustering is applied to group similar documents. Each text vector is assigned to the nearest cluster centroid based on a distance metric such as Euclidean distance. The centroids are iteratively updated by averaging the vectors within each cluster until the clustering process converges. How k-means clustering works:

*k*-means clustering [48] is an unsupervised machine learning algorithm that partitions a dataset into k clusters, where each cluster contains similar data points based on a defined distance metric. The process consists of the following steps:

(1) Initialization: The algorithm selects $k$ random points as initial centroids. These centroids represent the center of each cluster.

(2) Assignment of Data Points: Each document (represented as a vector from the TF transformation) is assigned to the cluster with the nearest centroid, using a distance metric such as Euclidean distance:

$$d(x_i, c_j) = \sqrt{\sum_{m=1}^{n} (x_{im} - c_{jm})^2} \quad (2.2)$$

where $x_i$ is the text vector, $c_j$ is the centroid of cluster $j$, and $n$ is the number of dimensions in the vector space.

(3) Updating Centroids: After all data points are assigned, the centroid of each cluster is updated by calculating the mean of all vectors assigned to it:

$$c_j = \frac{1}{N_j} \sum_{i=1}^{N_j} x_i \quad (2.3)$$

where $c_j$ is the updated centroid of cluster $j$, and $N_j$ is the number of documents in cluster $j$.

(4) Iteration and Convergence: Steps (2) and (3) are repeated until the centroids stabilize, meaning they no longer change significantly between iterations. This ensures that each document is assigned to its most appropriate cluster.

By applying k-means clustering to text data, this study effectively organizes unstructured textual information into meaningful groups, enabling deeper insights and facilitating further analysis.

Step 4: Evaluation using Recall

The final step involves evaluating the clustering performance using Recall [49], a metric that measures the proportion of correctly assigned data points in comparison to expert-defined labels. Recall is particularly important for clustering tasks where capturing all relevant data points is a priority.

In this context, True Positives (TP) represent correctly clustered documents, while False Negatives (FN) indicate relevant texts that were misclassified. The Recall metric ensures that the clustering approach is effective in grouping relevant documents while minimizing missing information.

By following this systematic methodology, the study effectively extracts, processes, and analyzes textual data, ensuring accuracy and meaningful insights through web scraping and machine learning techniques.

## 2.7 Short Video Evaluation

After using questionnaires to conduct pre-tests and post-tests on participants watching optimized short videos and collect data, this study applied the following statistical theories for analysis.

### 2.7.1 Cronbach's α

To ensure the reliability of the questionnaire data, Cronbach's α coefficient [50] was used for reliability analysis. Cronbach's α coefficient is one of the most used statistical indicators to test the reliability of the internal consistency of a questionnaire or scale and can reflect the degree of correlation or agreement between items of the measurement instrument. The basic formula for Cronbach's α is as follows:

$$\alpha = \frac{k}{k-1}\left(1 - \frac{\sum_{i=1}^{k}\sigma_i^2}{\sigma_X^2}\right) \quad (2.4)$$

where:

$k$: Indicates the number of items in a scale or questionnaire

$\sigma_i^2$: denotes the variance of the ith item

$\sigma_X^2$: Represents the variance of the total score of all items on the entire scale

For example, one study designed a short scale to measure a parameter, consisting of five items, and respondents' responses to each question were scored on a Likert Scale of 1 to 5 points. After surveying 30 respondents, you get the variance of the score and the variance of the total score for each question:

Table 1 An example data used for calculating Cronbach's α

| Question number | $\sigma_X^2$ |
|---|---|
| Q1 | 0.89 |
| Q2 | 0.76 |
| Q3 | 1.02 |
| Q4 | 0.84 |
| Q5 | 0.95 |

If the variance of the total score（$\sigma_X^2$） is 12.4, then Cronbach's α coefficient is calculated as:

$$\alpha = \frac{5}{5-1}\left(1 - \frac{0.89+0.76+1.02+0.84+0.95}{12.4}\right) \quad (2.5)$$

Calculation process:

$$\alpha = \frac{5}{4}\left(1 - \frac{4.46}{12.4}\right) = 1.25 \times (1 - 0.36) = 1.25 \times 0.64 = 0.80 \quad (2.6)$$

At this time, Cronbach's α was 0.80, indicating that the internal consistency reliability of the scale was good and could be used for follow-up research analysis.

2.7.2 Mean and Sample standard deviation

By analyzing the mean and standard deviation of the pre- and post-test data, the change trend of the research subjects before and after the intervention or experimental conditions and the stability of the data can be visually displayed. Where:

Mean [51] represents the concentrated trend of the data.

Sample standard deviation [52] indicates how discrete the sample data is (how much the data fluctuates or varies).

**Mean**

The mean is defined as the sum of all data values divided by the number of data values, and the formula is as follows:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n} \quad (2.7)$$

- $x_i$: The value of the ith sample data
- $n$: Sample size
- $\bar{x}$: is the arithmetic mean of the data

**Sample standard deviation**

The standard deviation of the sample is the sum of the squares of the difference between each data point and the mean divided by the number of data minus one. The formula is as follows:

$$s = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \bar{x})^2}{n-1}} \quad (2.8)$$

where:

- $x_i$: The value of the ith sample data
- $\bar{x}$: Sample mean
- $n$: Sample size

Suppose that in an experiment, 5 participants are given a pre-test (pre-intervention) and post-test (post-intervention) affective attitude score (0-100 points), and the data are as follows:

Table 2 An example data used for calculating Mean and Sample standard deviation

| Participant number | Pre-test score | Posttest score |
|---|---|---|
| 1 | 70 | 55 |
| 2 | 65 | 50 |
| 3 | 80 | 60 |
| 4 | 75 | 65 |
| 5 | 85 | 70 |

Step 1: Calculate the mean of the pretest and posttest

Pretest Mean:

$$\bar{x}_{pre} = \frac{70 + 65 + 80 + 75 + 85}{5} = \frac{375}{5} = 75 \quad (2.9)$$

Post-test mean:

$$\bar{x}_{post} = \frac{55 + 50 + 60 + 65 + 70}{5} = \frac{300}{5} = 60 \tag{2.10}$$

The results indicated that the average score after the intervention was 15 points lower than that before the intervention.

Step 2: Calculate the sample standard deviation for the pretest and posttest

Pre-test standard deviation:

$$s_{pre} = \sqrt{\frac{(70-75)^2 + (65-75)^2 + (80-75)^2 + (75-75)^2 + (85-75)^2}{5-1}}$$
$$s_{pre} = \sqrt{\frac{(-5)^2 + (-10)^2 + 5^2 + 0^2 + 10^2}{4}} = \sqrt{\frac{250}{4}} = \sqrt{62.5} \approx 7.91 \tag{2.11}$$

Post-test standard deviation:

$$s_{post} = \sqrt{\frac{(55-60)^2 + (50-60)^2 + (60-60)^2 + (65-60)^2 + (70-60)^2}{5-1}}$$
$$s_{post} = \sqrt{\frac{(-5)^2 + (-10)^2 + 0^2 + 5^2 + 10^2}{4}} = \sqrt{\frac{250}{4}} = \sqrt{62.5} \approx 7.91 \tag{2.12}$$

Step 3: Result Display:

Table 3 An example result for Mean and Sample standard deviation

| Index | Forward Test (Mean ± SD) | Post-test (Mean ± SD) |
|---|---|---|
| Attitude scores | 75 ± 7.91 | 60 ± 7.91 |

Through the above descriptive statistical analysis, it can be seen that the attitude score decreased significantly after the experiment, and the data fluctuated steadily.

2.7.3 Paired Samples t-test and Cohen's d

The paired samples t-test [53] is a statistical method used to compare whether there is a significant difference in the mean of the same group of subjects in two conditions or two measurements. Typically inferred: pre- and post-intervention comparisons of participants in the same group of participants and differences in a pair of interrelated data (e.g., differences in reaction speed between left and right hands of the same person). The statistical formula for the paired samples t-test is:

$$t = \frac{\bar{D}}{S_D/\sqrt{n}} \tag{2.13}$$

where:

- $\bar{D}$: The average value of the difference in the paired data;

- $S_D$: The standard deviation of the difference between the paired data, which is calculated as follows:

$$S_D = \sqrt{\frac{\sum_{i=1}^{n}(D_i - \bar{D})^2}{n-1}} \quad (2.14)$$

- $D_i$: The difference between the ith pair of data
- $n$: The number of logs of pairing data
- Degrees of freedom df: n-1

The results of the test should be determined whether there is a significant difference based on the given significance level (eg, α=0.05) and the t-distribution table of degrees of freedom.

For example, a teacher wanted to know if the course he teaching was was effective and tested the knowledge level of 5 students (out of 100) before and after attending the training. The data is as follows:

Table 4 An example data used for calculating t-test and Cohen's d

| Student Number | Pre-training score | Post-training score |
|---|---|---|
| 1 | 72 | 78 |
| 2 | 68 | 75 |
| 3 | 75 | 82 |
| 4 | 70 | 74 |
| 5 | 65 | 73 |

Step 1: Calculate the average of the differences

$$\bar{D} = \frac{6+7+7+4+8}{5} = \frac{32}{5} = 6.4 \quad (2.15)$$

Step 2: Calculate the standard deviation of the difference

$$S_D = \sqrt{\frac{(6-6.4)^2 + (7-6.4)^2 + (7-6.4)^2 + (4-6.4)^2 + (8-6.4)^2}{5-1}}$$
$$= \sqrt{\frac{(-0.4)^2 + 0.6^2 + 0.6^2 + (-2.4)^2 + 1.6^2}{4}} = \sqrt{\frac{0.16+0.36+0.36+5.76+2.56}{4}} = \sqrt{\frac{9.2}{4}} = \sqrt{2.3} \approx 1.5166 \quad (2.16)$$

Step 3: Calculate the t-value

$$t = \frac{\bar{D}}{S_D/\sqrt{n}} = \frac{6.4}{1.5166/\sqrt{5}} = \frac{6.4}{1.5166/2.2361} = \frac{6.4}{0.6785} \approx 9.43 \quad (2.17)$$

Step 4: Determine if it is significant

Assuming the significance level of α = 0.05 and the degrees of freedom df = 5 - 1 = 4, the cut-off value is about ±2.776 when df = 4 and α = 0.05 according to the t-distribution table (two-sided test).

The calculated t-value was 9.43, which was greater than the cut-off value of 2.776, so the difference was significant, i.e., the student performance after the training was significantly higher than before the training. Therefore, there was a significant difference in students' performance before and after the training by the paired sample t-test, indicating that the training was effective.

To further assess the effect size of this difference, the Cohen's d [54] was used to assess the actual effect size of the pre- and post-test changes. Cohen's d is a commonly used effect size measure of the size of the difference between the two groups or the strength of the intervention effect. It can help researchers determine whether differences are meaningful or not, rather than relying solely on statistical significance.

In a paired-sample t-test environment, the following formula is typically used to calculate Cohen's d:

$$d = \frac{\bar{D}}{S_D} \tag{2.18}$$

Where:

- $\bar{D}$: The average value of the difference in the paired data;
- $S_D$: Standard deviation of the difference in the paired data

Cohen's d provides a standardized measure of how much one group differs from another. The general effect size interpretation of effect size is:

d=0.2d：small effect

d=0.5d：medium effect

d=0.8d：large effect

Continuing the example of the paired sample t-test above, take the knowledge level test of 5 students before and after the training as an example:

Step 1: Calculate the average of the differences

$$\bar{D} = \frac{15 + 10 + 8 + 3 + 12}{5} = \frac{48}{5} = 9.6 \tag{2.19}$$

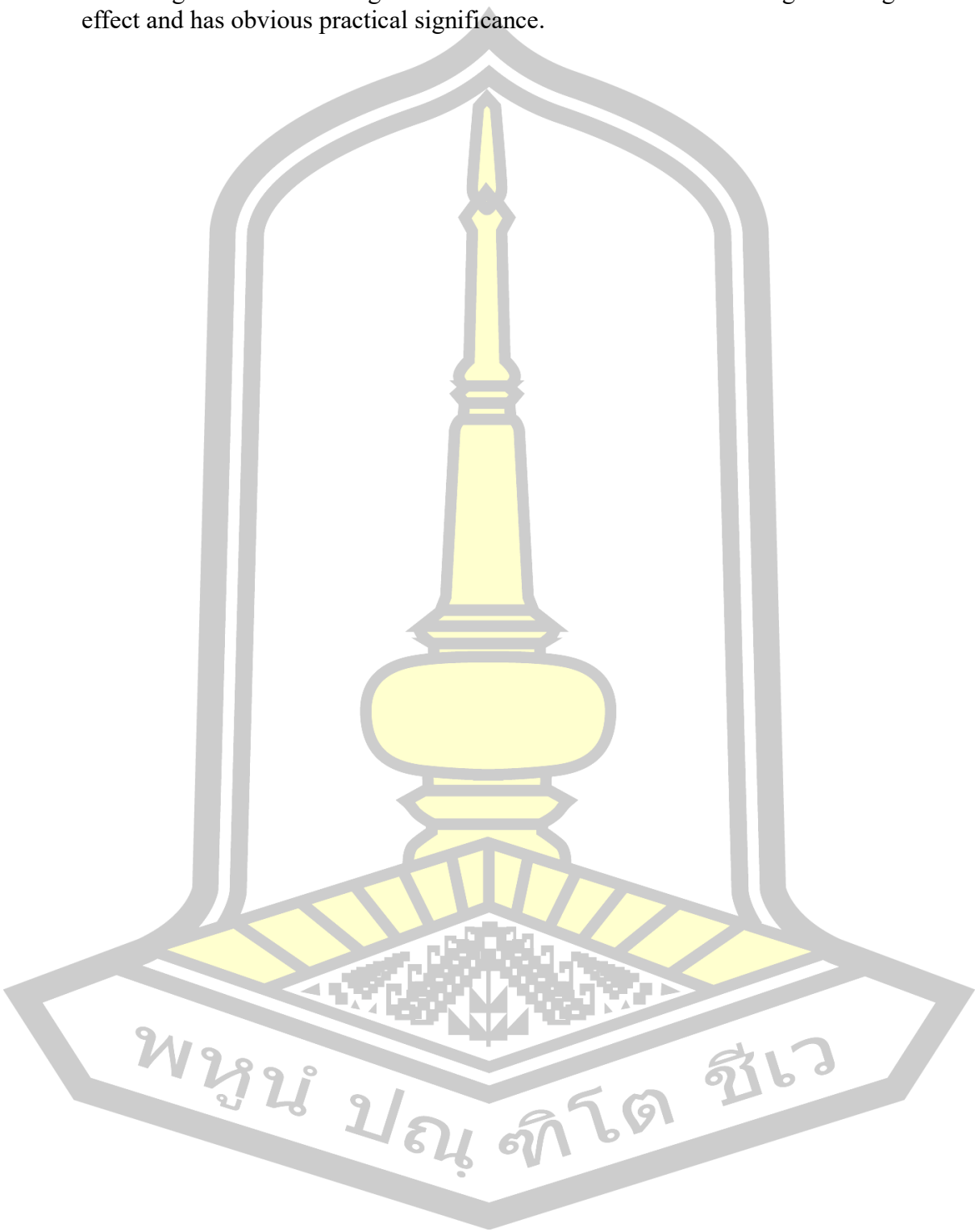
Step 2: Calculate the standard deviation of the difference $S_D$

$$S_D = \sqrt{\frac{(15 - 9.6)^2 + (10 - 9.6)^2 + (8 - 9.6)^2 + (3 - 9.6)^2 + (12 - 9.6)^2}{5 - 1}} \tag{2.20}$$

Step 3: Calculate Cohen's d value

$$d = \frac{\bar{D}}{S_D} = \frac{9.6}{\sqrt{24.28}} \approx \frac{9.6}{4.93} \approx 1.95 \tag{2.21}$$

The calculated d=1.95 indicates that the intervention effect is obvious (d>0.8), indicating that the knowledge level of the students after the training has a significant effect and has obvious practical significance.



# Chapter 3

# Research Methodology

This chapter describes the specific methodology and implementation steps used in this study. This study utilized a mixed research methodology, integrating quantitative and qualitative research methods to examine the effectiveness of short videos in the communication of mental health science, particularly depression in an aging population. The research methodology is divided into four phases: the first phase involves collecting and analyzing information related to short video design, including obtaining data through web crawling and cluster analysis, applying information design theory to construct video content, and identifying key design elements that affect the effectiveness of short videos; the second phase involves content planning based on a storytelling narrative approach; and the third phase involves combining multimedia learning with the results of the first phase's analysis and theoretical principles to complete the design and production of the short video content; the fourth stage evaluates the actual effects of these optimized video dissemination through a combination of quantitative (pre-test and post-test questionnaires) and qualitative (in-depth interviews), and conducts a comprehensive statistical and thematic examination using SPSS and NVivo software.

## 3.1 Collecting Relevant Information for Short Video Design

This section outlines the web scraping process used to collect web pages and blogs offering insights into short video design. Key elements include content style, font selection, visuals, background music, color schemes, and video length. While this information is general, it provides a foundational guide for structuring and enhancing video creation.

To gather relevant pages, we used various keywords and keyword groups, as shown in Table 3.1. Selecting Open Access web pages with clear, transparent content minimizes ethical concerns and ensures research reliability. We strictly collected publicly available information without bypassing technical protection. Table 3.2 presents examples of extracted content based on the selected keywords.

Table 5 Examples of keywords and keyword groups used for web scraping to gather relevant web pages and blogs

| Elements | Examples of keywords and keyword groups |
|---|---|
| Content style | • Content style for short science videos<br>• Short video content design for science<br>• Science communication video content tips<br>• Content strategies for educational science videos<br>• Best practices for short video content in science |
| Font selection | • Best fonts for science communication videos<br>• Font styles for educational short videos |

| Elements | Examples of keywords and keyword groups |
|---|---|
| | • Typography tips for short science videos<br>• How to choose fonts for educational videos |
| Visuals | • Visual design for science communication videos<br>• Best visuals for short science videos<br>• Tips for using visuals in science videos<br>• Graphic design for science communication videos |
| Background music | • Background music for science communication videos<br>• Choosing music for science-themed videos<br>• Music tips for educational video production<br>• Music for engaging science communication content |
| Color schemes | • Color schemes for science communication videos<br>• Color psychology in educational videos<br>• Choosing colors for science-themed short videos<br>• Effective use of colors in science communication |
| Video length | • Optimal video length for science communication<br>• Video length guidelines for educational content<br>• How long should science communication videos be?<br>• Recommended video duration for short educational videos |

The elements listed in Table 3.1 represent key design factors that significantly influence the effectiveness of short videos in science communication.

- Content style determines how information is structured and presented, which directly impacts clarity and audience engagement. A compelling content style helps transform complex scientific ideas into digestible narratives suitable for aging audiences.
- Font selection plays a critical role in readability, especially for older viewers. Fonts must be legible, appropriately sized, and free of decorative styles that may hinder comprehension.
- Visuals enhance understanding by reinforcing the message through imagery, animations, and diagrams. They are essential for maintaining attention and simplifying abstract concepts.

- Background music can create an emotional tone that complements the message. Appropriate music supports mood and pacing, but must be carefully selected to avoid distraction.
- Color schemes influence both aesthetics and cognitive processing. Using high-contrast, age-friendly color combinations helps improve visual comfort and guides viewer attention.
- Video length affects viewer retention and comprehension. Short, well-paced videos (typically under 60 seconds) are more likely to be watched in full and retain key messages among aging users with limited attention spans.

Table 6 Examples of outputs of web scraping

| Elements | Examples of outputs (or web pages) |
|---|---|
| Content style | Medium, Science Communication Blogs, Canva Blogs, HubSpot Blog |
| Font selection | Canva Blog, Adobe Creative Cloud, Visme Blog, Envato Tuts+, Piktochart Blog, HubSpot Blog |
| Visuals | Canva Design Blog, Adobe Blog, Visme Blog, Medium - SciComm Blogs, SciArt Blog, Envato Tuts+ |
| Background music | Chosic, Storyblocks, Taketones |
| Color schemes | Canva Blog, Visme Blog, Adobe Blog, Piktochart Blog, Toptal Design Blog, Nerdwriter Blog |
| Elements | xamples of outputs (or web pages) |
| Video length | ▪ https://www.techsmith.com/blog/video-length/?utm_source=chatgpt.com<br>▪ https://www.frontiersin.org/journals/communication/articles/10.3389/fcomm.2021.725811/full?utm_source=chatgpt.com<br>▪ https://www.boclips.com/blog/whats-the-optimum-length-for-an-instructional-video-and-why-does-it-matter?utm_source=chatgpt.com<br>▪ https://www.researchgate.net/publication/358949136_Chapter_29_Effective_Video_Use_in_Online_Learning |

Also, we would like to explain our research method for collecting relevant information for short video design, with an overview illustrated in Figure 3.1. Each step is described in detail as follows:

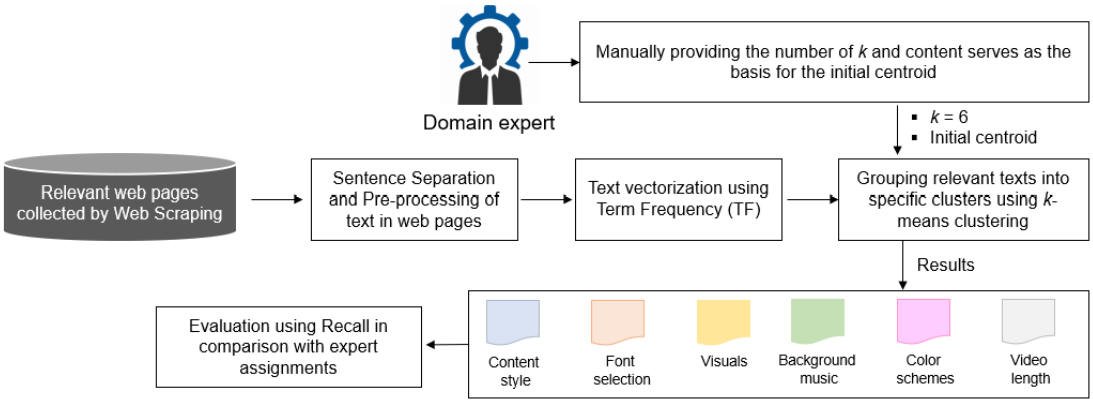



Figure 3 An overview of research method for collecting relevant information for short video design

3.1.1 Preliminary: Manually providing the number of k and content serves as the basis for the initial centroid

Manually determining the number of clusters, denoted as k, and selecting the initial content to define the centroids is a crucial step performed by a domain expert. This process requires a deep understanding of the data and its inherent structure to make informed decisions about the initial configuration. The domain expert's role involves identifying the optimal number of clusters that best represent the underlying patterns in the dataset and choosing representative content to serve as the starting point for the centroids. These initial centroids act as reference points for the clustering algorithm, providing a clear and meaningful foundation for grouping similar data points. By leveraging their expertise, the domain expert ensures that the clustering process begins with a well-informed and accurate setup, which significantly impacts the overall effectiveness and quality of the results.

3.1.2 Method for Collecting Relevant Information for Short Video Design

Each step involved in the proposed method is thoroughly explained in the following sections, providing a detailed breakdown of the process to ensure a clear understanding of its implementation and rationale. This step-by-step explanation highlights the purpose, approach, and significance of each phase, offering comprehensive insights into the methodology.

**Step 1: Sentence separation and pre-processing of text in web pages.** After retrieving English-relevant web pages through the web scraping process, the next step involves cleaning the text data by removing extraneous elements such as HTML tags, scripts, advertisements, and other irrelevant content extracted alongside the main text. Afterwards, sentence separation is performed to break the text into individual sentences, serving as a fundamental step in natural language processing (NLP). Sentence separation enhances the clarity, accuracy, and efficiency of the analysis, enabling the study to extract detailed insights from the data. Moreover, it ensures that subsequent tasks are applied to well-structured and meaningful text units, facilitating more accurate and reliable results.

Next, text pre-processing is performed to prepare the data for further analysis, and then the cleaned text undergoes tokenization, where the content is broken down

into smaller units like sentences or words for easier analysis. This is followed by lowercasing all text to maintain uniformity and ensure that the same words in different cases are not treated as separate entities.

Stop words, such as "*is*," "*the*," and "*and*," are then removed to eliminate words that do not contribute significantly to the context or meaning. Additionally, techniques such as stemming or lemmatization are applied to reduce words to their root forms, making the data more structured and consistent.

Finally, punctuation, special characters, and numerical values that are not relevant to the analysis are stripped away. This systematic pre-processing ensures that the text data is clean, organized, and ready for subsequent stages, such as feature extraction or modeling.

**Step 2: Text vectorization using Term Frequency.** The next step in the process is text vectorization using *Term Frequency* (*TF*), which involves transforming the cleaned and pre-processed text into numerical representations that can be analyzed computationally [25-27]. Using *TF* for term weighting in *k*-means clustering offers several advantages that make it a suitable choice for text-based data analysis. One of the key benefits is its ability to represent textual information in a way that emphasizes the significance of frequently occurring terms within individual documents. By calculating the frequency of each term, *TF* helps capture the unique characteristics of a document, ensuring that clusters are formed based on meaningful patterns in the data. In *k*-means clustering, the goal is to group similar documents together based on their features. *TF* provides a straightforward numerical representation of text, transforming unstructured textual data into a structured format that algorithms like *k*-means can process. This transformation is computationally efficient and ensures that each document is represented by its term frequencies, making it easier to compare and group documents based on shared features. Moreover, *TF* effectively highlights the prominent themes in each document. Documents with similar term frequency patterns are more likely to belong to the same cluster, as *k*-means minimizes the distance between data points in a multidimensional space. By weighting terms based on their frequency, *TF* allows the clustering algorithm to focus on the most relevant features, while terms that occur less frequently or are absent have minimal impact on the clustering process. Another significant advantage is *TF*'s ability to normalize term frequencies, especially in datasets with documents of varying lengths. Normalization ensures that longer documents do not dominate the clustering process simply due to their higher term counts. This balanced representation is crucial for achieving meaningful and accurate clustering results. The formula of *TF* can be presented as follows.

$$TF(w,d) = \frac{freq(w,d)}{\sum_{w' \in d} freq(w',d)} \tag{3.1}$$

where *w* is the specific term for which the frequency is being calculated. *d* the document in which the term frequency is being measured. *freq*(*w, d*) The raw frequency count of term *w* in document *d*, i.e., the number of times *w* appears in *d*. $\sum_{w' \in d} freq(w', d)$ is the total number of terms in document *d*.

This step results in a numerical representation of the text that retains the information needed for further analysis while discarding unnecessary or redundant details. By using *TF*, the text data becomes structured, enabling more sophisticated methods like clustering analysis to be applied.

**Step 3. Grouping relevant texts into specific clusters using *k*-means clustering.** In this stage, each text vector is assigned to the cluster whose centroid is nearest, based on a distance metric such as Euclidean distance. The distance is calculated as:

$$d(x_i, c_j) = \sqrt{\sum_{m=1}^{n} (x_{im} - c_{jm})^2} \quad (3.2)$$

where $x_i$ is a text vector in the dataset, $c_j$ is the centroid of cluster $j$, and $n$ is the number of dimensions in the vector space.

Once all data points are assigned to clusters, the centroids are updated by calculating the mean of all data points within each cluster:

$$c_j = \frac{1}{N_j} \sum_{i=1}^{N_j} x_i \quad (3.3)$$

where $c_j$ is the updated centroid of cluster $j$, $N_j$ is the number of points in cluster $j$, and $x_i$ are the data points in the cluster.

The process of assigning points to clusters and recalculating centroids is repeated until the centroids stabilize, meaning no further changes occur. This is known as convergence.

The algorithm produces $k$ clusters, each containing texts with similar features. These clusters represent meaningful groupings, making it easier to identify themes, patterns, or topics within the text data. Using *k*-means clustering to group relevant texts transforms unstructured data into structured insights. By leveraging this method, analysts can uncover hidden patterns and gain a deeper understanding of the relationships within large volumes of text.

**Step 4. Evaluation using Recall in comparison with expert assignments.** This stage is a methodical approach to assess the performance of *k*-means clustering in organizing data into meaningful groups. Recall measures the proportion of relevant data points correctly identified by the clustering algorithm in comparison to the assignments provided by domain experts. This metric is particularly valuable for evaluating the quality of clusters when the focus is on capturing all relevant instances for a given cluster. Recall is a commonly used metric in evaluating classification and clustering tasks. It is defined as:

$$Recall = \frac{TP}{TP + FN} \quad (3.4)$$

where *TP* (*true positives*) represents the number of relevant items correctly assigned to a cluster, while *FN* (*false negatives*) represents the number of relevant items that were not assigned to the appropriate cluster.

In the context of k-means clustering, TP represents the data points correctly grouped into clusters that align with expert-defined assignments, while FN refers to relevant data points that were misplaced or missed by the algorithm. Recall is sufficient for the evaluation in this study because it emphasizes the algorithm's ability to include all relevant items, which is critical when missing relevant data could lead to significant inaccuracies. In applications like text clustering, the priority often lies in retrieving all

relevant texts for analysis rather than minimizing false positives. In addition, recall provides a straightforward measure of performance that is easy to calculate and interpret, especially when expert-defined labels are available for comparison.

### 3.2 Collecting Information from Samples

This study employed a combination of purposive sampling and snowball sampling to ensure a representative and relevant sample for both quantitative and qualitative data collection:

Questionnaire Sample (Quantitative Study): A purposive sampling approach was used to select active TikTok users who have experience watching short videos. This method ensures that the respondents are familiar with the medium and can provide meaningful insights into the effectiveness of short videos in science communication.

In-depth Interview Sample (Qualitative Study): A snowball sampling technique was applied to select participants for in-depth interviews. A subset of respondents from the questionnaire sample was randomly chosen and invited to participate, and they were encouraged to recommend other suitable participants. This method helped gather diverse perspectives and obtain richer, more nuanced qualitative data.

Sample Description - The study included two distinct groups:

1. Quantitative Study Sample:

A total of 363 respondents participated in the questionnaire survey.

- The age range of participants was 18 to 60 years old.
- The gender distribution was 48.5% male and 51.5% female.
- On average, respondents spent 1 to 3 hours per day using short video platforms.

2. Qualitative Study Sample:

- A total of 46 respondents were selected from the quantitative sample for one-on-one in-depth interviews.
- The interview sessions lasted between 10 to 20 minutes.
- Participants were chosen based on their ability to provide insightful reflections on short video engagement, user behavior, and communication effectiveness.

The purposive sampling strategy ensured that only individuals with relevant experience in watching short videos on TikTok were included, enhancing the validity of the findings. Meanwhile, snowball sampling allowed for a more diverse range of interview participants, helping to capture a wide spectrum of user experiences and behaviors. This approach strengthened the reliability and applicability of the study's results, making them more reflective of real-world user interactions with short-form science communication content.

## 3.3 Research Tools

### 3.1.1 AI Tools

Data Collection Using Scrapy - The Scrapy framework (Python) was used to automate data extraction from various online platforms, including health forums, social media platforms, and video comment sections. This process enabled the collection of user-generated discussions that provided valuable insights into audience engagement, concerns, and perceptions regarding elderly depression.

Text Preprocessing - The Natural Language Toolkit (NLTK) was used to remove HTML tags, stop words, punctuation, and special characters, eliminating unnecessary elements from the extracted text. Also, the spaCy library was utilized for tokenization, breaking down the text into meaningful units. Additionally, lemmatization was performed to convert words into their root forms, ensuring that different word variations were treated as the same entity.

Clustering Techniques - The k-means clustering algorithm (implemented using Scikit-learn) was used to categorize similar discussions into clusters based on shared themes and sentiment. This helped group user-generated content into meaningful categories, revealing key engagement factors and discussion trends.

### 3.1.2 Questionnaires

Questionnaires are a widely used data collection tool in research fields such as sociology, psychology, and market analysis. It consists of structured questions designed to gather information on opinions, behaviors, attitudes, and knowledge. Questionnaires can be paper-based or electronic and may include open-ended or closed-ended questions.

Survey Star, a leading online survey platform in China, offers over 90 question types (e.g., multiple-choice, Likert scales, and matrix questions) and supports logic-based structures. It provides real-time data collection, basic statistical analysis, and data export in formats like Excel and SPSS. Survey Star is mobile-friendly and supports multiple distribution channels, including QR codes, WeChat, and email. It ensures privacy protection through encrypted transmission and anonymous responses, making it a preferred tool for large-scale data collection, especially during the pandemic.

This study utilized Survey Star to design and distribute an online questionnaire. The survey covered demographics and key variables such as user habits, content preferences, interaction behaviors, trust, emotional empathy, and satisfaction. Most questions used a five-point Likert scale (1 to 5) to quantify attitudes. The questionnaire was disseminated through social media, ensuring broad reach among internet users. Data were exported for analysis using SPSS, ensuring reliability and participant confidentiality.

To validate the study's methodology, an expert review panel assessed short video samples using two established evaluation tools:

- Global Quality Score [55]: Assesses health information quality based on accuracy, usability, reliability, timeliness, and transparency.
- Modified DISCERN [56]: Evaluates the quality of written health information, focusing on clarity, relevance, source credibility, balance, and currency.

These benchmarks ensured that expert evaluations remained objective and unaffected by individual questionnaire biases.

Table 7 Global Quality Score (GQS) benchmark criteria

| Score | Global Score Description |
|---|---|
| 1 score | poor quality, poor traffic, most information missing, not of any use to the patient |
| 2 score | Generally poor quality with poor flow, some information listed but many important topics lacked, of very limited use to patients |
| 3 score | medium quality with suboptimal flow, some of the main information was fully discussed but other information discussed insufficiently, somewhat helpful to patients. |
| 4 score | Good quality and generally goo flow, most of the relevant information is listed, but some topics not covered, useful to patients. |
| 5 score | Excellent quality and excellent flow, very useful for patients |

### 3.1.3 In-Depth Interviews

In-depth interviews are a qualitative research method used to explore participants' experiences, attitudes, and motivations beyond what questionnaires capture. Unlike structured surveys, interviews allow open-ended responses, offering deeper insights into behavioral patterns and decision-making factors.

This study conducted semi-structured interviews, preparing key questions while allowing flexibility for follow-ups. Interviews focused on user behavior, content preferences, interaction motivations, trust levels, emotional resonance, and overall satisfaction. Purposeful sampling ensured diversity among respondents, selecting participants based on their questionnaire responses (e.g., high/low satisfaction or engagement levels).

Interviews were conducted face-to-face or via remote methods (video or phone), lasting 10–20 minutes. Before starting, researchers explained the study's purpose and confidentiality terms. Conversations were recorded with consent, and notes were taken to capture key insights. Transcriptions were later analyzed using NVivo for qualitative coding, identifying common themes and underlying factors not evident in the questionnaire data.

By combining quantitative survey data with qualitative interviews, this study achieved a comprehensive understanding of user behavior, trust-building mechanisms, and emotional engagement. These insights provide valuable interpretations and support evidence-based recommendations for further improvements.

### 3.1.4 IBM SPSS

IBM SPSS (Statistical Package for the Social Sciences) is a widely used statistical analysis software known for its user-friendly interface and comprehensive statistical capabilities. It supports a range of analyses, from basic descriptive statistics to advanced inferential modeling, including hypothesis testing, regression analysis, and multivariate techniques like cluster analysis and factor analysis. SPSS also excels in data management, allowing users to filter, transform, and clean datasets efficiently.

A key feature of SPSS is its ability to assess scale reliability, such as computing Cronbach's α coefficient, which evaluates the internal consistency of questionnaire items. This ensures that multiple items measuring the same construct (e.g., user trust) produce reliable results. Additionally, SPSS facilitates mean comparisons, including

paired-samples and independent-samples t-tests, to examine statistical differences between groups.

This study used SPSS for data cleaning, reliability testing, descriptive analysis, and paired-samples t-tests.

- Data Cleaning: The raw data from Survey Star was imported into SPSS for validation. Invalid responses (e.g., incomplete or randomly answered surveys) were removed, missing values were handled appropriately, and reverse-coded items were adjusted.
- Reliability Analysis: Cronbach's α was computed to confirm the internal consistency of questionnaire scales.
- Descriptive Statistics: Demographic distributions (e.g., gender, age), user behavior patterns, and content preferences were analyzed using frequency tables, means, and standard deviations.
- Paired-Samples T-Test: This test was used to compare pre-test and post-test results from the same participants, determining whether significant differences existed between the two phases. The t-value and p-value ($p < 0.05$) indicated statistical significance.

By leveraging SPSS, this study ensured rigorous data analysis, enhancing the reliability and validity of its findings. The software's robust statistical capabilities provided a solid foundation for quantitative research conclusions.

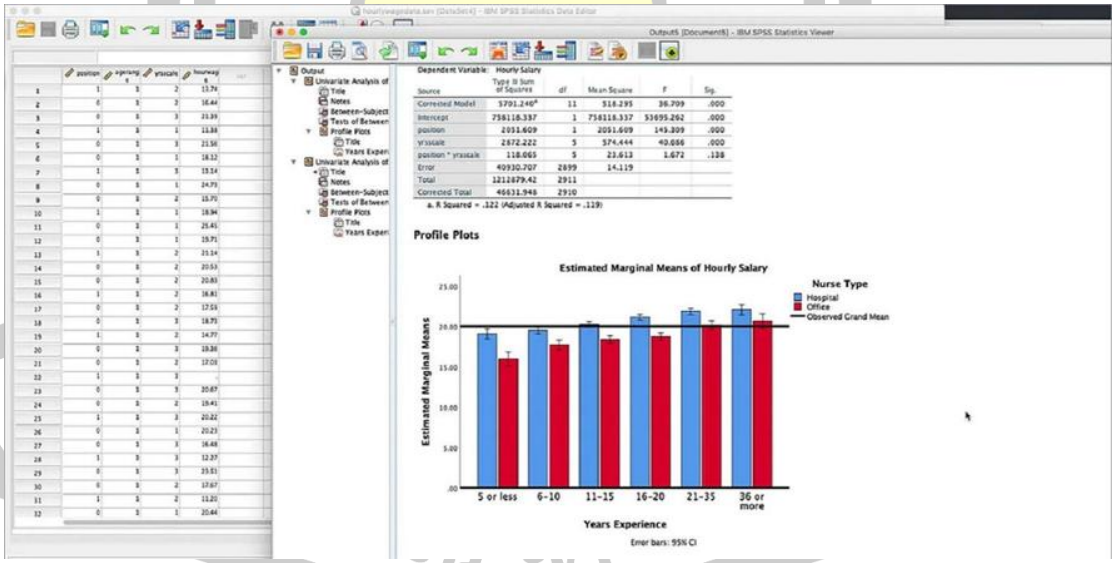



Figure 4 IBM SPSS 29.0

3.1.5 NVivo

NVivo, developed by QSR International, is a widely used qualitative data analysis software designed for encoding and thematic analysis of unstructured data such

as interviews, texts, and reports. As a Computer-Aided Qualitative Data Analysis Software (CAQDAS), NVivo helps researchers manage, code, and query large datasets efficiently.

The core function of NVivo is coding, where researchers label (or code) text fragments to classify raw data into relevant themes or concepts. NVivo organizes codes using nodes, functioning like hashtags, allowing researchers to drag and drop text segments for structured classification. Additionally, NVivo supports powerful retrieval and analysis functions, enabling keyword frequency analysis, coding matrix queries, and comparative analysis across different groups.

After conducting in-depth interviews, the recorded audio was transcribed into text and imported into NVivo 15.0 for systematic coding and analysis.

- Data Coding: NVivo's node structure helped categorize text segments, making it easier to track themes from open coding to core themes.
- Retrieval & Validation: The software allowed instant retrieval of text excerpts under each node, ensuring transparency and traceability in the analysis process.
- Thematic Analysis: Key themes in user behavior and attitudes were identified, and relationships between them were examined.

NVivo streamlined the complex interview data into structured research findings, offering deeper insights. These qualitative results complemented the quantitative questionnaire findings, enriching the study's conclusions with more context and depth.

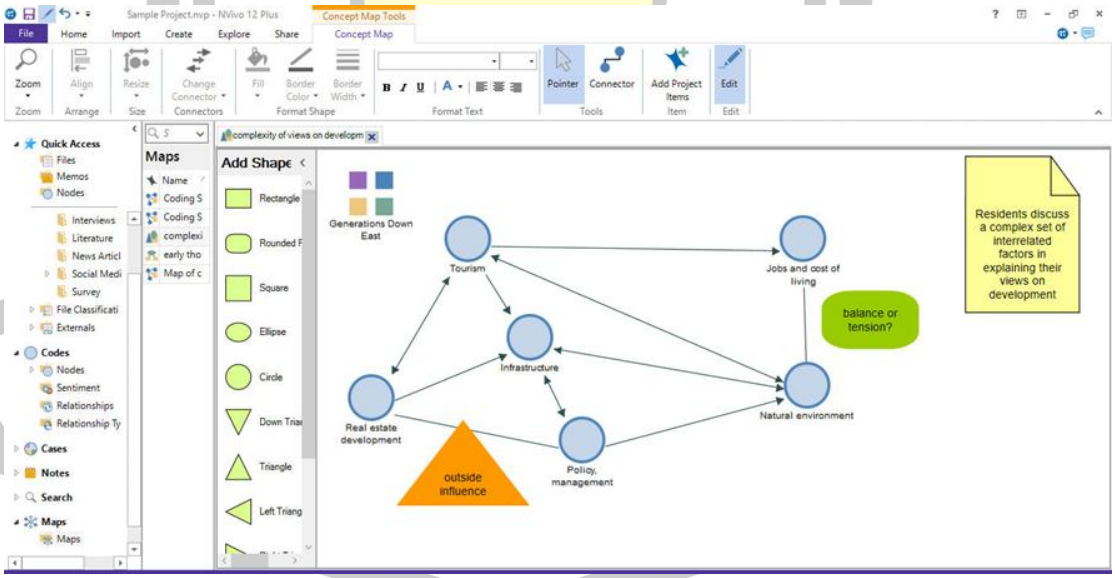



Figure 5 Nvivo

### 3.4 Research Method: How to Design Short Video for Science Communication Related to Mental Health?

This study adopts a multi-phase research methodology to systematically design, develop, and evaluate short videos for science communication, specifically targeting mental health knowledge related to depression. The research method is structured into four main phases, integrating both quantitative and qualitative approaches. The methodology is grounded in Information Design Theories and Multimedia Learning Theory, which guide the development and assessment of short video content. The overall research workflow is as follows:

Phase 1: Collecting and Analyzing Relevant Information for Short Video Design

- Web scraping and clustering analysis (Section 3.1)
- Application of Information Design Theories for structuring video content
- Identification of key elements (e.g., content style, font selection, visuals, background music, color schemes, video length)

Phase 2: Storytelling

Phase 3: Designing and Developing Short Video Content

- Utilizing findings from Phase 1 to create optimized short videos
- Incorporating principles from Multimedia Learning Theory to enhance engagement and comprehension

Phase 4: Evaluating the Effectiveness of Short Video Communication

- Conducting a quantitative study (survey-based analysis)
- Conducting a qualitative study (in-depth interviews)
- Analyzing data using SPSS and NVivo

The overview of research framework can be presented as Figure 3.6. Each phase is explained in detail below.

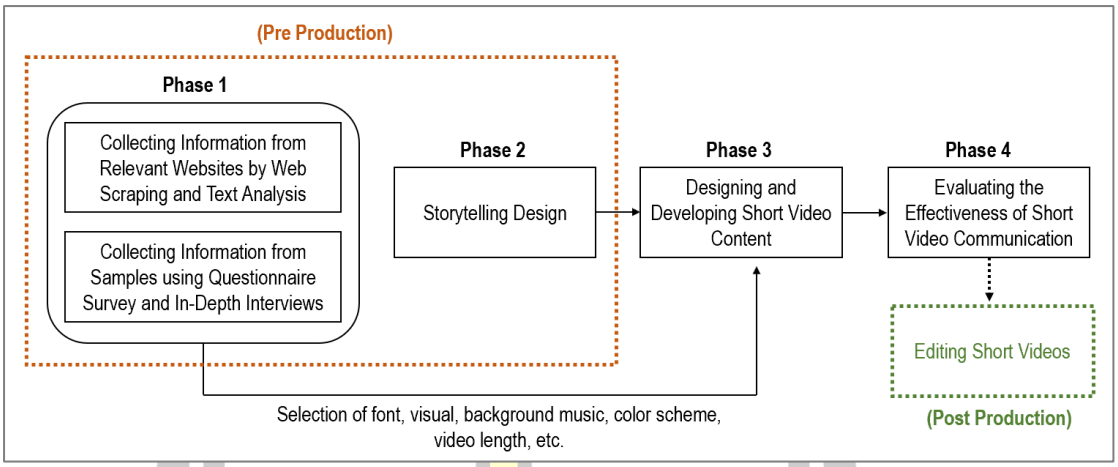



Figure 6 The overview of research framework

3.4.1 Phase 1: Collecting and Analyzing Relevant Information for Short Video Design

3.4.1.1 Collecting Information from Relevant Websites by Web Scraping and Text Analysis (Referred to Section 3.1)

To ensure evidence-based content design, web scraping was used to collect and analyze publicly available web pages and blogs discussing best practices in short video creation. The extracted information focused on following key elements:

- Font selection
- Visuals
- Background music
- Color schemes
- Video length

After data collection, natural language processing (NLP) techniques were applied to preprocess the text:

- Sentence separation
- Tokenization
- Stop word removal
- Stemming/Lemmatization
- Text vectorization using Term Frequency (TF)

Finally, using k-means clustering, the extracted text was grouped into six categories corresponding to the identified key elements. The clustering process was validated using expert evaluations and recall analysis.

The categorized data from web scraping and clustering analysis was used to inform the structural and aesthetic design of short video content. The Information Design Theories provided a theoretical foundation for organizing and presenting content effectively, ensuring:

**Clarity and readability (font selection and content style)**

Information design theory emphasizes the need to improve the clarity and readability of information through appropriate font selection and content style, and it is recommended to use sans-serif fonts (such as Microsoft Yahei, Siyuan Heiti) and large font sizes, and adopt a clear content layout.

The latest information design research emphasizes that font and content design directly affect the efficiency of user cognitive processing and information memory [57]. Especially for the elderly, visual function and cognitive processing ability decrease significantly with age. Sans-serif fonts and larger font sizes are effective in reducing visual fatigue and cognitive load during reading [58]. In addition, a clear content style and hierarchical layout can effectively reduce the confusion of the elderly audience in the process of information processing and improve the efficiency of information transmission [59].

**Visual appeal and engagement (color schemes and visuals)**

Information design theory requires that visual elements be attractive, with sound color schemes and visuals to increase visual interest and engagement. The color matching follows the principle of low saturation and high contrast, with warm colors supplemented by soft and cool colors, and combined with MG animation to show information.

Recent research in the field of information design [60] shows that color schemes have a significant guiding effect on the audience's attention and mood, especially low-saturation warm colors (such as beige and light orange) are more suitable for the visual perception characteristics of the elderly, helping to alleviate anxiety and improve viewing comfort [61]. Regarding visual effects, MG animation has been confirmed by the latest research to effectively reduce cognitive load and significantly enhance the visual appeal and audience engagement of information due to its graphic, concise, and interactive nature [62]. Compared with traditional videos, MG animation can attract attention faster, stimulate emotional resonance, and effectively reduce information acceptance barriers in the elderly group [63].

**Audio-visual harmony (background music and pacing)**

Information design theory emphasizes that the presentation of information should consider the harmony and unity of multiple senses, and the rhythm and atmosphere of sound and picture should be harmonious. The background music should be soft and soothing (piano, light music) and ensure that the rhythm of the video clip is stable and smooth.

According to the latest research on information design and multi-channel information processing [64], when visual and auditory elements are harmonized, information transmission can be significantly enhanced, cognitive load and distraction can be reduced. Especially for older audiences, soothing and smooth background music can significantly improve emotional experience, reduce anxiety and fatigue during viewing, and thus improve information acceptance [65]. In addition, audiovisual

harmony can effectively avoid the waste of cognitive resources caused by sensory conflicts and improve the overall communication efficiency of information design [66].

**Optimal video length for retention (video duration guidelines)**

Information design theory emphasizes that the length and rhythm of information presentation should be accurately set according to the cognitive characteristics, attention maintenance time and information processing ability of the audience to ensure the effective transmission and understanding of information. For short video content for the elderly, it is recommended to limit the optimal length to 2-3 minutes.

According to Sweller's Cognitive Load Theory [67], individual working memory capacity is limited, and when the information presentation time exceeds the threshold of the audience's cognitive load, it will lead to cognitive fatigue, decreased attention, and even information forgetting or resistance. There is a significant decrease in attention span, memory maintenance efficiency and information processing speed in the elderly population [68], so a shorter duration (2-3 minutes) can better match the attention characteristics of the elderly group and avoid cognitive overload. The latest research on the communication effect of short videos [69] pointed out that videos longer than 3 minutes significantly lead to attention attenuation, affecting the memory and comprehension of information.

This phase established the foundational principles for structuring the short videos before content production.

3.4.1.2 Collecting Information from Samples using Questionnaire Survey and In-Depth Interviews

This stage aims to explore the effectiveness of short videos in science communication by analyzing user behavior and engagement on TikTok. Based on the combination of purposive sampling for the quantitative study and snowball sampling for the qualitative study, the expected outcomes can be categorized as follows:

1. Quantitative Findings (Questionnaire Survey)

- User Behavior on Short Video Platforms:
  - o Average time spent on TikTok per day (e.g., 1-3 hours).
  - o Frequency of engagement with science-related content.
  - o Types of short videos that attract users' attention.
- Perceived Effectiveness of Short Videos in Science Communication:
  - o Level of comprehension after watching science-related short videos.
  - o User engagement metrics, including interest, attention, and interaction.
  - o Factors influencing retention and sharing of scientific content.
- Demographic Influence on Viewing Behavior:
  - o Impact of age and gender on engagement with science-related short videos.
  - o Differences in perception and response to science content among various user groups.

2. Qualitative Findings (In-Depth Interviews)

- User Perspectives on Science Communication through Short Videos:

o Perceived strengths and limitations of short videos for conveying scientific knowledge.

o Trustworthiness and credibility of science content on TikTok.

o Key elements that encourage user engagement, such as liking, commenting, or sharing videos.

- User Behavior and Experience in Engaging with Science Content:

o Characteristics of short videos that effectively capture user interest.

o Influence of content creators and influencers on audience perception.

o Strategies users employ to assess misinformation or unreliable science content.

- Recommendations for Improving the Effectiveness of Science Communication via Short Videos:

o Presentation techniques that enhance comprehension and retention.

o Elements that contribute to content credibility and trust.

o Factors that increase the likelihood of a video being shared or going viral.

The findings will provide insights into TikTok user behavior related to science communication. The study will identify key factors that enhance engagement and effectiveness of science-related short videos. The results will offer practical recommendations for science communicators and content creators to optimize their short-form video strategies. The study's insights may contribute to future strategies for using short videos in science education and public engagement on digital platforms. By addressing these aspects, this study aims to enhance the understanding of short video-based science communication, paving the way for more effective and engaging content strategies in digital media.

This phase established the foundational principles for structuring the short videos before content production.

3.4.2 Phase 2: Storytelling

The exoected short videos will follow the classic three-act structure commonly used in educational storytelling:

Act 1: Introduction (Setting the Scene)

Visuls:

- A soft, warm-toned MG animation scene of an elderly individual sitting alone, looking out the window.
- The clock ticks, showing time passing, but no visitors come.
- Subtle visual cues like dim lighting, slow movements, and sighs reflect loneliness.

Voiceover/Narration:

- *"Do you know that millions of elderly individuals suffer from depression, often unnoticed by those around them?"*
- *"Geriatric depression is real, but it is often mistaken for normal aging."*

Key Elements:

- Introduces the main character – an elderly person experiencing loneliness.
- Establishes the problem – depression in the elderly is often overlooked.
- Emotionally engaging – creates a sense of empathy in the audience.

Act 2: Conflict & Awareness (The Struggle)

Visuls:

- A sequence showing the elderly character struggling with daily life:
  - Sitting at the dinner table but eating very little.
  - Lying awake at night, staring at the ceiling.
  - Ignoring phone calls or social interactions.
- Text pop-ups with key facts:
  - *"Depression affects 15-20% of people over 60."*
  - *"Many seniors don't realize they need help."*

Voiceover/Narration:

- *"The signs of geriatric depression are not always obvious—fatigue, lack of interest, and withdrawal from loved ones."*
- *"Sometimes, it is mistaken for forgetfulness or a part of aging, but it is much more than that."*

Key Elements:

- Highlights specific symptoms of depression.
- Users' real-world statistics to establish credibility.
- Reinforces the urgency of addressing the issue.

Act 3: Solution & Hope

Visuls:

- The character's environment brightens as family members and caregivers show support.
- A doctor explains treatment options in a friendly, animated style.
- Key action points appear on screen:
  - *"Talk to your loved ones."*
  - *"Seek professional support."*
  - *"Encourage social engagement."*

Voiceover/Narration:

- *"Depression in the elderly is treatable. Small actions—listening, checking in, and encouraging medical care—can make a big difference."*

- *"You can be the reason someone feels seen and heard."*

Key Elements:

- Introduces practical solutions and actionable steps.
- Reinforces positive emotions through brighter visuals.
- Ends with a call to action to encourage audience engagement.

3.4.3 Phase 3: Designing and Developing Short Video

The second phase involved the creation of short videos based on findings from Phase 1. Here, Multimedia Learning Theory was applied to enhance user engagement and knowledge retention.

3.4.3.1Applying Multimedia Learning Principles

*Mayer's Multimedia Learning Theory* provides fundamental principles for designing effective educational content by optimizing how humans process and retain information. When applied to short videos for science communication, particularly on topics such as mental health and elderly depression, this theory ensures that information is delivered in a way that enhances comprehension, engagement, and retention. According to Mayer's Multimedia Learning Theory, effective science communication via short videos should:

- Reduce cognitive load by structuring information logically - Cognitive load theory suggests that human working memory has a limited capacity, and if too much information is presented at once, it can overwhelm the learner, reducing understanding and retention.

o Segment information into digestible chunks: Instead of presenting all details at once, break down concepts into logical sections. For example, a video explaining depression in elderly individuals can be divided into causes, symptoms, and coping strategies, each covered separately.

o Use clear and concise narration: Avoid overly technical jargon or complex sentence structures. Instead, use simple language and direct explanations to facilitate understanding.

o Provide a clear visual hierarchy: Important points should be highlighted using on-screen text, graphics, or animations. This ensures that viewers focus on key messages without unnecessary distractions.

o Minimize extraneous cognitive load: Avoid presenting irrelevant visuals, excessive animations, or background music that competes with narration. The goal is to direct the viewer's attention to essential content without unnecessary distractions.

By structuring information logically and progressively, viewers can process and retain knowledge without feeling overwhelmed.

- Use dual-channel processing (visual and auditory elements) - The Dual-Channel Hypothesis states that humans process information through two primary channels:

o The visual channel (images, graphics, animations, text)
o The auditory channel (spoken explanations, sound effects, music)

To optimize learning in short videos, both channels should be used effectively and complement each other:

o Combine narration with relevant visuals: Instead of displaying large blocks of text, use visuals (diagrams, infographics, animations) to reinforce spoken explanations. For instance, when discussing how depression affects brain chemistry, an animated illustration of neurotransmitters can be shown while the narrator explains.

o Avoid redundancy: Displaying large amounts of text on-screen while simultaneously reading it aloud can overload the learner. Instead, use concise bullet points or keywords to summarize spoken content while keeping the narration as the primary information source.

o Use synchronized visuals and audio: If an animation is explaining how stress affects mental health, the narration should describe the process in real-time, ensuring that the viewer's auditory and visual processing are aligned.

By balancing visual and auditory modalities, short videos ensure that information is absorbed more efficiently and that both channels reinforce each other rather than competing for attention.

- Employ coherence and signaling principles to highlight key messages - The Coherence Principle suggests that removing unnecessary information enhances learning, while The Signaling Principle emphasizes the importance of guiding learners toward key points. To implement these principles in short videos:

o Eliminate unnecessary content: Avoid using extraneous details, excessive background music, or decorative visuals that do not support learning. For example, if explaining depression treatment options, the focus should be on medications, therapy, and self-care strategies, rather than including unrelated statistics.

o Use signaling cues to highlight critical information:

- Text overlays: Displaying key terms or phrases on-screen (e.g., “Early Signs of Depression: Fatigue, Anxiety, Insomnia”) reinforces learning.

- Visual emphasis: Use bold colors, arrows, underlining, or zoom effects to draw attention to critical areas in graphics or animations.

- Narration cues: The speaker can use emphasis (pauses, changes in tone, or repetition) to direct attention to important points (e.g., “The most crucial step in depression treatment is…seeking professional help”).

o Maintain a structured flow: Every video should have a clear beginning, middle, and end. A logical sequence (such as problem → explanation → solution) helps viewers retain and apply the knowledge.

By removing distractions and guiding attention, short videos can enhance clarity, retention, and comprehension, ensuring that the key messages are effectively communicated.

3.4.3.2 Video Production Process

The video production process was guided by the insights gained from Phase 1, where best practices for designing short science communication videos were identified. This phase involved the actual creation of short videos incorporating the most effective

elements to optimize viewer engagement and knowledge retention. The process was structured around three key components: content structuring, visual design, and audio design.

1. Content Structuring - To ensure clarity and improve audience comprehension, the videos were systematically structured using the following strategies:

Clear headings and section divisions: Each video was segmented into logical sections with concise, attention-grabbing headings, making it easier for viewers to follow the content.

Short, digestible segments: Instead of presenting large blocks of information, the videos used bite-sized content chunks, aligning with cognitive load principles to prevent information overload.

Narrative flow optimization: Information was presented in a logical, progressive manner, ensuring a smooth transition between concepts.

These techniques aimed to maintain audience attention and facilitate better information retention, particularly for aging audiences engaging with mental health topics.

2. Effective Visual Design - Visual elements played a critical role in enhancing comprehension and engagement. The videos incorporated:

- Appropriate color schemes: Colors were selected based on color psychology principles to evoke the intended emotions and enhance message clarity. For example, cooler tones (blue, green) were used to create a calming effect, aligning with the mental health theme.
- Engaging animations and graphics: Motion graphics and simple animations were utilized to illustrate complex scientific concepts, ensuring the content remained dynamic and visually stimulating.
- Font selection for readability: Legible, easy-to-read fonts were chosen to accommodate diverse viewers, including older adults.

By applying Information Design Theories, the visual elements were optimized to improve information processing and audience engagement.

3. Cohesive Audio Design - Audio elements were carefully integrated to complement the visual content and enhance comprehension:

- Background music selection: Music tracks were chosen based on their ability to reinforce the emotional tone of the message without overwhelming the spoken content. Soft, non-distracting background music was used to create a relaxed and inviting atmosphere.
- Narration pacing and clarity: The voice-over narration followed clear, well-paced delivery, ensuring the content was accessible to a broad audience, including non-native speakers and older viewers.

This approach aligns with Multimedia Learning Theory, which emphasizes the integration of visual and auditory elements to enhance comprehension and retention.

4. Expert Review and Refinement - To ensure the accuracy and scientific validity of the content, the initial video drafts were reviewed by experts in science communication. These experts provided feedback on:

- Scientific accuracy and clarity of the presented information.
- Engagement level and effectiveness of the content in capturing the audience's attention.
- Accessibility and inclusivity, ensuring the videos were suitable for a diverse audience, particularly aging individuals interested in mental health topics.

Based on this expert feedback, necessary revisions were made to refine the videos before final production and distribution on the TikTok platform.

By integrating the best practices identified in Phase 1, applying Information Design and Multimedia Learning Theories, and incorporating expert review, the final short videos were designed to effectively communicate mental health knowledge in an engaging, accessible, and scientifically accurate manner.

3.4.4 Phase 4: Evaluating the Effectiveness of Short Video Communication

The final phase focused on evaluating the impact of the developed short videos through quantitative and qualitative research methods.

3.4.4.1 Quantitative Study: Survey-Based Analysis

A structured questionnaire was administered to 363 participants (Section 3.3). The survey covered:

- User engagement and interaction behaviors
- Knowledge retention and comprehension
- Trust and credibility of information
- Emotional resonance and perception of video quality

The collected data was analyzed using:

- IBM SPSS for descriptive and reliability analysis
- IBM SPSS AMOS for structural equation modeling (SEM) to examine causal relationships

3.4.4.2 Qualitative Study: In-Depth Interviews

To gain deeper insights, 46 participants were selected from the survey respondents for semi-structured interviews. Key topics included:

- Perceived clarity and impact of video content
- Factors influencing engagement and trust
- Suggestions for improvement

Interview data was analyzed using NVivo:

- Open Coding to identify emerging themes
- Axial Coding to group related themes
- Selective Coding to construct a comprehensive framework

3.4.4.3 Age-Based Segmentation and Evaluation Rationale

Although the primary target audience is aging people, the evaluation also included participants across different age groups, including their adult children or caregivers. Therefore, to better understand how different generations perceive and respond to the video content, the data were analyzed by segmenting participants into two main age groups:

- Group A: Aging individuals (60 years and older)
- Group B: Adult family members (typically aged 30–59)

This segmentation allows the study to assess differences in emotional resonance, trust, comprehension, and behavioral intent between those directly experiencing age-related mental health concerns and those supporting them.

SPSS and NVivo were used to analyze responses separately by group. The results, later interpreted in Chapter 4, provide more nuanced insights into how each age group engages with and benefits from the video content, thus strengthening the validity and relevance of the findings.

3.4.5 Theoretical Integration and Process Connectivity

This section provides an overview of how each phase of the research process is interconnected and how Information Design Theory and Multimedia Learning Theory are applied at each stage. It also clarifies how the outputs from each step inform the subsequent phases and contribute to the overall effectiveness of the short video communication strategy.

**Phase 1: Data Collection and Analysis**

- What is done: Web scraping and keyword-based clustering are used to collect and organize online content related to depression and mental health from reputable sources such as PubMed and health blogs.
- Theoretical relevance: This phase is informed by Information Design Theory, which emphasizes relevance, user needs, and clarity of content. Clustering helps to distill complex health information into focused themes suitable for communication.
- Contribution to next step: The identified themes and topics serve as the basis for scripting and narrative planning in the storytelling phase, ensuring that the content is evidence-based and aligned with user interests.
- Benefit: Ensures that the final content is data-driven, up-to-date, and aligned with public discourse and informational gaps.

**Phase 2: Storytelling and Content Design**

- What is done: Key messages are developed into scripts and visual storyboards using principles of narrative structure and emotional design.
- Theoretical relevance: Information Design Theory guides visual layout, font selection, and message organization to maximize accessibility for aging viewers. Multimedia Learning Theory is integrated through the design of content sequencing and segmentation.
- Contribution to next step: The storyboards provide the blueprint for video production, ensuring both clarity and engagement.
- Benefit: Enhances cognitive processing, ensures clarity of scientific messages, and increases emotional engagement.

**Phase 3: Short Video Production and Distribution**

- What is done: Video production is carried out using animation, voiceovers, and background music, followed by distribution on TikTok.
- Theoretical relevance: Multimedia Learning Theory is directly applied through principles such as dual-channel processing, temporal and spatial contiguity, and personalization. These principles inform the pacing, visuals, and audio design of the videos.
- Contribution to next step: Finalized videos become the stimulus materials for evaluation in the next phase.
- Benefit: Maximizes message retention, comprehension, and viewer satisfaction through optimized multimedia presentation.

**Phase 4: Evaluation**

- What is done: The effectiveness of the videos is evaluated using a combination of expert review (GQS, DISCERN), pre/post surveys, user interaction data from TikTok, and qualitative interviews.
- Theoretical relevance: This phase validates how well the theoretical principles—especially from Information Design Theory and Multimedia Learning Theory—translated into user comprehension, trust, and behavioral response.

- Feedback loop: The evaluation results provide insights into which design elements are most effective, offering guidance for future iterations and scalable content design.

- Benefit: Ensures continuous improvement and confirms that theory-based design results in measurable impact among aging audiences.

This structured alignment between theory and process ensures methodological transparency, enhances academic rigor, and allows each stage to contribute meaningfully to the final outcomes of the research.

3.4.6 Summary of Evaluation Criteria and Their Interpretations

This subsection summarizes how the effectiveness of each phase is measured, what specific aspects are evaluated, and how the results are interpreted.

*Phase 1 (Data Collection and Clustering)*: Effectiveness is measured using Recall to assess the accuracy of clustering results compared to expert labeling. A high recall score indicates that the clustering method successfully identifies relevant and meaningful topic groups, which are used to guide content development.

*Phase 2 (Storytelling Design)*: Evaluation focuses on narrative clarity, emotional resonance, and alignment with multimedia learning principles. Effectiveness is determined through expert review feedback and pre-evaluation rubrics. Positive expert feedback suggests strong content structure and audience relevance.

*Phase 3 (Video Production and Distribution)*: Effectiveness is assessed using engagement metrics on TikTok (views, likes, comments, shares). High interaction rates imply successful visual communication and audience interest. These metrics help determine which video elements most effectively capture attention.

*Phase 4 (Outcome Evaluation)*: Three aspects are evaluated:

1) Content credibility and clarity – rated by domain experts using GQS and DISCERN tools. High scores indicate trustworthiness and comprehensibility.

2) Cognitive impact – measured using pre- and post-test scores, analyzed via t-tests and Cohen's d. Statistically significant improvements suggest effective knowledge transfer.

3) Affective response and behavioral intent – gathered from interviews and comment analysis via NVivo. Insights into emotional impact and willingness to share or act upon the information indicate persuasive strength.

## 3.5 Ethical Considerations

Ensuring ethical integrity was a fundamental aspect of this study, particularly in handling participant data and interactions. The research adhered to established ethical guidelines to safeguard the rights, privacy, and well-being of all participants. The following measures were implemented to maintain ethical standards:

3.5.1 Informed Consent

Ensuring ethical integrity was a fundamental aspect of this study, particularly in handling participant data and interactions. The research adhered to established ethical guidelines to safeguard the rights, privacy, and well-being of all participants. The following measures were implemented to maintain ethical standards:

Before participating in the study, all respondents were provided with a detailed informed consent form, explaining the research objectives, procedures, and their rights as participants. The form outlined:

- The voluntary nature of participation, emphasizing that individuals could withdraw at any stage without consequences.
- The scope of data collection, including what information would be gathered and how it would be used.
- Potential risks and benefits associated with participation.
- Contact information for the research team in case of questions or concerns.

Participants were required to sign or digitally acknowledge the consent form before proceeding with the survey or interviews, ensuring that they fully understood the terms of their involvement.

3.5.2 Anonymity

To protect participant privacy, all responses were anonymized before data processing. This means that:

- Personal identifiers (e.g., names, email addresses, IP addresses) were not recorded or were removed during data handling.
- Each participant was assigned a unique but untraceable code, ensuring that responses remained confidential.
- When reporting results, only aggregated data or anonymized excerpts from interviews were presented, preventing the identification of individual participants.

This approach ensured that participants could provide honest and unbiased responses without concern for personal exposure.

By implementing these measures, the study maintained ethical responsibility, participant trust, and compliance with data protection regulations throughout the research process.

# Chapter 4

# Results and Discussion

This chapter has presented selected screens from the proposed short videos for science communication on depression in aging individuals, developed using 2D modeling. Additionally, it has outlined the results of the video evaluation, which was conducted using expert assessment, paired-samples t-test, and Cohen's d.

## 4.1 Some Screens from the Proposed Short Videos

This short video sample was produced in the form of motion graphics (MG) animation, utilizing Adobe After Effects (AE) and DaVinci Resolve 19 for post-production.

***Pre-Production Planning*** - The videos were developed based on key influencing factors outlined in the model. The pre-production process included scriptwriting, storyboard creation, scene planning, and character design to ensure effective storytelling and visual engagement.

***Visual Style*** - The MG animation features a simple and clean artistic style, designed to emphasize character emotions and enhance the clarity of information. Dynamic charts were used to present key data on geriatric depression, including incidence rates and symptom statistics, to improve the credibility of the content. Subtitles and icon animations were incorporated into key sections to enhance emphasis and improve the overall viewing experience.

***Post-Production*** - Color adjustments were applied in DaVinci Resolve 19 to achieve a cohesive and visually appealing look. Additionally, animation optimization in Adobe After Effects enhanced smoothness and improved the viewing experience. Professional voice-over recordings were conducted in a studio to increase credibility and audience engagement. The background music and sound effects were carefully selected to create a soothing and warm atmosphere, aligning with the emotional tone of the video. Additionally, subtle ambient sounds were integrated to enhance the sense of immersion.

Some samples of the proposed short videos for science communication on depression in aging individuals can be illustrated as follows.

Figure 7 MG animation character design with Adobe After Effects


Figure 8 Post-production with DaVinci Resolve 19

Figure 9 Studio recording

**4.2 Expert Assessments (Scientific & Academic Quality of Content)**

To ensure the scientific accuracy, credibility, and ethical integrity of the short video, this study invited five experts from relevant fields, including psychology, communication, medicine, media technology, and ethics, to form an evaluation panel. The experts assessed the video using two standardized evaluation scales:

- Global Quality Scale (GQS) – A metric used to evaluate the overall quality, reliability, and comprehensibility of digital content, particularly in health-related media.
- DISCERN Scale – A validated tool for assessing the credibility, transparency, and quality of health information presented in media.

The evaluation results are summarized in Table 4.1, which presents the individual scores provided by each expert along with the average scores for both assessment scales.

Assessments of Experts using GQS and DISCERN scales

| Assessment scales | Number of questions | Expert 1 | Expert 2 | Expert 3 | Expert 4 | Expert 5 | Average score |
|---|---|---|---|---|---|---|---|
| GQS | 5 | 4.25 | 4 | 4.5 | 4.25 | 4 | 4.2 |
| DISCERN | 5 | 4.33 | 4 | 4.33 | 4 | 4.33 | 4.2 |

As shown in Figure 4.1, the experts provided ratings across both assessment scales:

- The GQS scale received an average score of 4.2, indicating that the experts found the short video to be of high quality, clear, and informative in its approach to science communication.

- The DISCERN scale also received an average score of 4.2, suggesting that the experts deemed the video content credible, evidence-based, and well-structured for public dissemination.

Since both scales received scores above 4.0, the results indicate that the experts highly recognized the scientific, academic, and ethical standards maintained in the video. They also agreed that the video was well-structured and effective in communicating scientific concepts to the public.

4.2.1 Expert Recommendations and Refinements

Beyond numerical evaluations, in-depth interviews were conducted with each expert to gather qualitative feedback for further improvement. Their key insights are summarized below:

- Expert 1 (Psychology): Acknowledged the video's accurate portrayal of elderly depression but recommended enhancing the use of real-life scenarios to increase audience empathy.
- Expert 2 (Communication): Praised the narrative structure and communication strategy but suggested incorporating interactive questions at the end to boost audience engagement.
- Expert 3 (Medicine): Highly rated the medical accuracy of the video and recommended citing authoritative sources more clearly to enhance academic credibility.
- Expert 4 (Media Technology): Recognized the strength of MG animation in knowledge dissemination but advised optimizing animation speed and information density to balance cognitive load and ensure optimal information retention.
- Expert 5 (Ethics): Commended the respectful and considerate portrayal of elderly individuals but suggested avoiding potential stereotypes to ensure a positive and inclusive representation.

4.2.2 Final Adjustments and Future Implementation

Based on expert feedback, the short video underwent further refinements to improve its scientific rigor, clarity, and engagement. Adjustments included:

- Enhancing real-life contextualization to strengthen audience connection.
- Adding interactive elements to increase participation.
- Clearly citing authoritative medical sources to improve credibility.
- Refining animation pacing and information density for better comprehension.
- Ensuring ethical representation of elderly individuals.

These optimizations ensure the video is well-prepared for official release on TikTok, where it aims to effectively communicate scientific knowledge on depression in aging populations.

In summary, the expert evaluation confirms that the short video meets high standards of scientific, academic, and ethical quality. With an average expert rating of 4.2 on both the GQS and DISCERN scales, the video demonstrates strong potential for effective science communication. The final refinements, based on expert recommendations, further enhance its impact, making it a reliable tool for public education on geriatric depression.

## 4.3 Assessment of Consumer Engagement and Experience

The study assessed user engagement and experience by examining how effectively the short science video on geriatric depression influenced audience trust, emotional response, interaction, and overall satisfaction. These factors were evaluated using both quantitative and qualitative methods, providing a comprehensive understanding of user reactions and behavioral changes.

### 4.3.1 Quantitative Assessment of Engagement & Experience

#### *4.3.1.1 Pre-Test and Post-Test Evaluation*

The study implemented a pre- and post-test experimental design to measure changes in user attitudes and behaviors before and after watching the short video. Participants completed a 5-point Likert scale questionnaire covering six key dimensions:

(1) User Trust – Perceived credibility and reliability of the video content.

(2) Emotional Resonance – The extent to which the video emotionally engaged users.

(3) Overall Satisfaction – General impression of the video's quality and effectiveness.

(4) Content Preferences – User interest in the format, visuals, and storytelling style.

(5) Interactive Behavior – User participation in liking, commenting, and sharing.

(6) User Habits – Changes in science video consumption habits.

#### 4.3.1.2 Statistical Analysis of Engagement

SPSS 27.0 was used to conduct:

- Descriptive Statistics – Analyzed the mean (M) and standard deviation (SD) of pre-test and post-test scores.
- Paired Samples t-test – Assessed whether the short video led to statistically significant changes in engagement factors.
- Effect Size Analysis (Cohen's d) – Measured the strength of the impact across different engagement dimensions.

Key results from quantitative analysis can be presented as Table 4.2.

Table 8 Key results from quantitative analysis for Engagement & Experience

| Dimension | Pre-test (M) | Post-test (M) | Effect Size (Cohen's d) | Significance |
|---|---|---|---|---|
| Overall Satisfaction | 3.17 | 3.92 | 0.96 (Large) | $p < 0.001$ |
| User Trust | 3.25 | 3.91 | 0.89 (Large) | $p < 0.001$ |
| Emotional Resonance | 3.12 | 3.86 | 0.85 (Large) | $p < 0.001$ |
| Content Preference | 3.40 | 3.89 | 0.65 (Moderate) | $p < 0.05$ |
| Interactive Behavior | 3.22 | 3.79 | 0.72 (Moderate) | $p < 0.05$ |
| User Habits | 3.18 | 3.63 | 0.52 (Moderate) | $p < 0.05$ |

Interpretation of Results:

- User trust, emotional resonance, and overall satisfaction showed significant improvements, confirming that the short video successfully engaged viewers.
- Content preference and interactive behavior showed moderate improvements, suggesting that users found the video engaging but further interactive features could enhance participation.
- User habits had the smallest effect size, indicating that while the video influenced short-term behavior, long-term habit formation requires additional strategies.

4.3.2 Qualitative Assessment of Engagement & Experience

This stage applies In-Depth Interviews & Thematic Analysis that can be explained as follows.

- One-on-one interviews were conducted with all 46 participants after completing the post-test questionnaire.
- Interview topics focused on:
  - Comprehension of video content (Was the information clear and understandable?)
  - Knowledge acquisition (Did users learn new health-related concepts?)
  - User preferences (Which aspects of the video—animation, colors, narration—enhanced
- Nvivo 15.0 was used for qualitative data coding and thematic analysis:
  - Open coding: Identified key engagement themes.
  - Axial coding: Organized common patterns in responses.
  - Selective coding: Extracted core themes to explain engagement factors.

The key findings from qualitative analysis can be presented as Table 4.3

Table 9 Key findings from qualitative analysis for Engagement & Experience

| Core Theme | Findings |
|---|---|
| **Comprehension of Video Content** | 92% of users reported that the content was **clear and easy to understand**. However, 7% found some **medical terms (e.g., neurotransmitters) difficult to grasp**. |
| **Knowledge Acquisition** | 84% of users stated that the video **helped them gain new health-related knowledge**, particularly on **depression symptoms, psychological interventions, and family support strategies**. |
| **User Preferences for Video Presentation** | 100% of users expressed specific preferences: **MG animation (85%)**, **color scheme (63%)**, and **sound effects (52%)** were the most engaging elements. |

User testimonials can be:

- *"The animation made it easy to understand symptoms of geriatric depression."*
- *"I realized the importance of family support in mental health recovery."*
- *"The warm colors and voice-over created a comfortable viewing experience."*

Additional findings and recommendations for improvement are:

(1) User habits showed weaker effects compared to other dimensions

- Many participants still preferred entertainment content over educational videos.
- Recommendation: Future content should incorporate edutainment strategies to sustain long-term engagement.

(2) Interactive features need enhancement - While user interaction increased, participants suggested adding more engaging features, such as:

- Real-time Q&A sessions
- Mini-games or reward-based interactions
- More personalized engagement strategies

(3) Medical terminology needs to be simplified - 7% of participants struggled with technical terms, emphasizing the need for:

- Simpler explanations
- Use of analogies and visual aids

(4) Desire for real-life cases & expert endorsements - 27% of users wanted real-life case studies or expert appearances to enhance credibility and relatability.

- Recommendation: Future videos should incorporate authentic narratives or expert commentary.

(5) Emotional design significantly enhances engagement - 85% of users highlighted that the warm, soothing visuals and audio design created a more engaging and immersive experience.

The stage provided a comprehensive evaluation of user engagement and experience, revealing that:

- Trust, emotional resonance, and satisfaction are the strongest predictors of engagement.
- Interactive features and real-life relevance enhance audience participation.
- Simplifying complex medical terms improves content accessibility.
- Emotional design elements (color, animation, music) play a crucial role in audience retention.

By integrating both quantitative and qualitative insights, the findings offer a strategic foundation for improving short-form science communication videos, ensuring they are both engaging and educational.

**4.4 Assessment of Behavioral Impact and Interaction**

This stage evaluated behavioral impact and user interaction by measuring how the short science video influenced audience engagement, habits, and interactive behaviors. The assessment was conducted using both quantitative and qualitative methods, including a pre-test and post-test questionnaire survey, statistical analysis, and in-depth interviews.

4.4.1 Quantitative Assessment of Behavioral Impact and Interaction

4.4.1.1 Pre-Test and Post-Test Experimental Design

- Participants completed a baseline (pre-test) survey before watching the short video to assess their existing behaviors, habits, and interaction levels with science-related content.
- After watching the video for two consecutive months, the same participants completed a post-test survey to measure changes in their interaction behaviors and content engagement.
- A 5-point Likert scale questionnaire was used, covering:

1. User Habits – Changes in content consumption patterns and preferences.
2. Interactive Behavior – User engagement activities such as likes, comments, and shares.

4.4.1.2 Statistical Analysis of Behavioral Impact - SPSS 27.0 was used for:

- Descriptive statistics – Examined mean (M) and standard deviation (SD) in pre-test and post-test scores.

- Paired Samples t-test – Determined significant differences in behavioral changes before and after watching the video.
- Effect Size Analysis (Cohen's d) – Measured the magnitude of change in interaction and behavioral impact.

Key results from behavioral impact analysis can be presented as Table 4.4.

Table 10 Key results from behavioral impact analysis for Behavioral Impact and Interaction

| Dimension | Pre-test (M) | Post-test (M) | Effect Size (Cohen's d) | Significance |
|---|---|---|---|---|
| User Habits | 3.18 | 3.63 | 0.52 (Moderate) | $p < 0.05$ |
| Interactive Behavior | 3.22 | 3.79 | 0.72 (Moderate) | $p < 0.05$ |

Interpretation of results are:

- User habits improved moderately, indicating that the short video influenced audience preferences and viewing behaviors, but long-term habit formation requires further engagement strategies.
- Interactive behavior significantly increased, suggesting that the video successfully encouraged audience participation through likes, comments, and shares.

4.4.2 Qualitative Insights on Behavioral Impact and Interaction

One-on-one interviews were conducted with all 46 participants to explore their engagement behaviors and interaction patterns. Interview topics included:

- Changes in viewing habits (Did users start watching more science-related videos?)
- Participation in interactive features (Did users comment, share, or engage with the video content?)
- Motivations for engagement (What encouraged users to interact with the video?)

Nvivo 15.0 was used for qualitative coding and thematic analysis, categorizing user responses into three core themes. Key findings from qualitative analysis can be presented as Table 4.5.

Table 11 Key Findings from Qualitative Analysis for Behavioral Impact and Interaction

| Core Theme | Findings |
|---|---|
| **Changes in User Habits** | 54% of users reported that while they enjoyed the video, they still preferred **entertainment-focused content** over educational videos. |
| **Interactive Behavior** | Users engaged more **in likes and shares**, but many found the interactive elements **not engaging enough**. |
| **Motivation for Engagement** | Users suggested adding **more interactive features** (e.g., real-time Q&A, mini-games, expert endorsements) to encourage deeper participation. |

User Testimonials:

- "I started watching more science-related videos, but I still prefer entertainment content."
- "I liked the video and shared it, but I wasn't motivated to comment because there wasn't a direct call-to-action."
- "Adding interactive quizzes or live discussions would make me engage more."

Areas for improvement and recommendations are:

- User habits showed weaker changes compared to other dimensions - Many participants still preferred entertainment over educational content. Recommendation is to incorporate edutainment strategies (blending education with entertainment) to maintain long-term engagement.
- Interactive elements need improvement - While engagement increased, users found the interactive features lacking innovation. Recommendation is to add interactive quizzes, real-time feedback, mini-games, or live expert discussions to enhance participation.
- Need for stronger calls-to-action - Users engaged more in liking and sharing, but less in commenting due to the absence of direct prompts. Recommendation is to include clear prompts for audience participation, such as question-based interactions or discussion topics.

## 4.5 Assessment of Effectiveness of Video Presentation & Design

The stage evaluated the effectiveness of the video presentation and design to determine how well the visual, auditory, and interactive elements contributed to the audience's engagement, comprehension, and satisfaction. The assessment incorporated both quantitative and qualitative methods, using a questionnaire survey, statistical analysis, and in-depth interviews.

### 4.5.1 Quantitative Assessment of Video Presentation & Design

#### 4.5.1.1 Pre-Test and Post-Test Evaluation

A 5-point Likert scale questionnaire was used to measure audience perceptions of video design quality, visual appeal, and audio clarity. Participants completed the

questionnaire before and after watching the video, allowing for a comparison of initial expectations versus post-viewing experiences. The evaluation focused on the following aspects:

1. Visual & Animation Quality – Clarity, smoothness, and engagement level of the MG animation.
2. Information Accessibility – Ease of understanding the scientific and medical content.
3. Audio & Voice Narration – Effectiveness of the voice-over, background music, and sound design.

4.5.1.2 Statistical Analysis of Video Presentation Effectiveness

SPSS 27.0 was used for:

- Descriptive statistics – Mean (M) and standard deviation (SD) were analyzed for each dimension.
- Paired Samples t-test – Assessed whether video design factors significantly influenced audience perception.
- Effect Size Analysis (Cohen's d) – Determined the magnitude of impact of visual and auditory elements.

Key results from video presentation analysis can be presented as Table 4.6.

Table 12 Key results from video presentation analysis for video presentation & design

| Dimension | Pre-test (M) | Post-test (M) | Effect Size (Cohen's d) | Significance |
|---|---|---|---|---|
| Visual & Animation Quality | 3.45 | 3.98 | 0.71 (Moderate) | $p < 0.05$ |
| Information Accessibility | 3.30 | 3.89 | 0.76 (Moderate) | $p < 0.05$ |
| Audio & Voice Narration | 3.52 | 4.02 | 0.85 (Large) | $p < 0.001$ |

Interpretation of results is:

- Animation quality and visual design significantly improved user engagement, confirming that MG animation was effective in presenting scientific content.
- Information accessibility scores increased, but some users struggled with technical medical terms, indicating a need for simpler language and explanatory visuals.
- Audio and voice narration had the strongest impact, suggesting that professional voiceovers and background music enhanced audience comprehension and emotional connection.

4.5.2 Qualitative Insights on Video Presentation & Design

One-on-one interviews were conducted to explore audience perceptions of video aesthetics, clarity, and engagement levels. Interview topics included:

- Perceived quality of animation and visual style (Did users find the visuals engaging and clear?)
- Challenges in understanding medical content (Were technical terms explained effectively?)
- Impact of audio and sound design (Did the narration and music enhance the message?)

Nvivo 15.0 was used for qualitative coding and thematic analysis, identifying key themes in user feedback. Key findings from qualitative analysis can be presented as Table 4.7.

Table 13 Key findings from qualitative analysis for video presentation & design

| Core Theme | Findings |
|---|---|
| Visual Appeal & Animation Quality | 85% of users appreciated the **MG animation style**, describing it as **engaging, intuitive, and visually appealing**. |
| Comprehension & Information Accessibility | 7% of users found **medical terms difficult to understand**, suggesting the need for **simplified explanations or graphical aids**. |
| Audio & Emotional Engagement | 63% of users felt that the **background music and narration enhanced emotional resonance**, making the video **more immersive and persuasive**. |

User testimonials are:

- "The animation was clear and engaging, making it easier to follow the message."
- "Some medical terms were difficult to grasp; adding simple explanations would help."
- "The voice-over was warm and professional, making the content feel trustworthy."

Areas for improvement and recommendations are:

1. Enhancing Information Accessibility - Some users struggled with technical terms, reducing content clarity. Recommendation is to use simpler language, analogy-based explanations, and visual aids (e.g., infographics) to improve accessibility.
2. Optimizing Interactive Elements - While the visuals and audio were effective, interactive features were limited. Recommendation is to incorporate clickable infographics, animated quizzes, or expert Q&A segments to boost engagement.
3. Refining Audio & Sound Design - Narration was highly effective, but some users preferred more variation in tone. Recommendation is to use dynamic voice modulation and synchronized sound effects to enhance key messages.

## 4.6 Assessment of Ethical and Social Considerations

The study also assessed ethical and social considerations to evaluate the appropriateness, inclusivity, and social responsibility of the short science video on geriatric depression. The evaluation focused on respect for the elderly, potential stereotypes, credibility of information, and the ethical responsibility of disseminating

health-related content. Both quantitative and qualitative methods were used to ensure that the video met ethical standards and social expectations.

4.6.1 Ethical Evaluation Criteria

The study incorporated expert evaluations and audience feedback to examine ethical aspects, including:

- Respect and Representation of the Elderly – Ensuring that the video portrayed elderly individuals with dignity, avoiding stereotypes.
- Scientific and Medical Credibility – Evaluating whether medical information was sourced from authoritative references.
- Inclusivity and Social Sensitivity – Assessing whether the video addressed the topic in a way that was accessible and non-discriminatory.
- Ethical Responsibility in Health Communication – Ensuring that the video provided accurate and responsible health information.

4.6.2 Expert Evaluation on Ethical and Social Considerations

4.6.2.1 Multi-Disciplinary Expert Review

Five experts from psychology, communication, medicine, media technology, and ethics were invited to assess the ethical and social dimensions of the video. The GQS scale and DISCERN scale were used to measure the academic, ethical, and rational aspects of the video content. Key findings from expert review are:

- Respect for the Elderly: Experts praised the video for its empathetic tone and avoidance of negative stereotypes, but suggested more diverse case studies to reflect different experiences.
- Medical Accuracy: The medical expert commended the accuracy of the information, but recommended clearly citing authoritative sources to enhance credibility.
- Social Sensitivity: The ethics expert noted that the video treated depression with compassion but suggested ensuring diverse representation in future videos.

4.6.2.2 Quantitative Results from Expert Evaluation

The average score across the five experts for ethical, academic, and scientific quality was above 4.0, indicating high reliability and trustworthiness.

4.6.3 Audience Perception of Ethical and Social Considerations

4.6.3.1 In-Depth Interviews on Ethical Aspects

46 participants were interviewed to understand their perceptions of ethical and social considerations in the video. Interview themes focused on:

- Perceived trustworthiness of medical information

- Fair and respectful representation of elderly individuals
- Emotional impact and sensitivity of the content

4.6.3.2 Key Findings from Qualitative Analysis

Table 14 Key Findings from Qualitative Analysis for Ethical and Social Considerations

| Core Theme | Findings |
|---|---|
| **Trust in Medical Information** | 74% of users believed the video **provided reliable information**, but 27% suggested adding **more explicit citations from medical experts**. |
| **Respect for the Elderly** | 89% felt the video **treated aging and depression with respect**, while 11% noted that **more diverse perspectives on elderly experiences could be included**. |
| **Ethical Responsibility in Health Messaging** | 68% of users stated that the **content was well-balanced and did not induce unnecessary fear**, ensuring responsible communication of health-related information. |

User testimonials are:

- *"The video is educational, but I would feel more confident if it clearly referenced medical experts or research sources."*
- *"It portrays elderly depression in a caring way, but it would be great to see different cultural perspectives included."*
- *"I appreciate that the video raises awareness without creating fear. It feels responsible and well-structured."*

4.6.4 Areas for Ethical Improvement and Recommendations

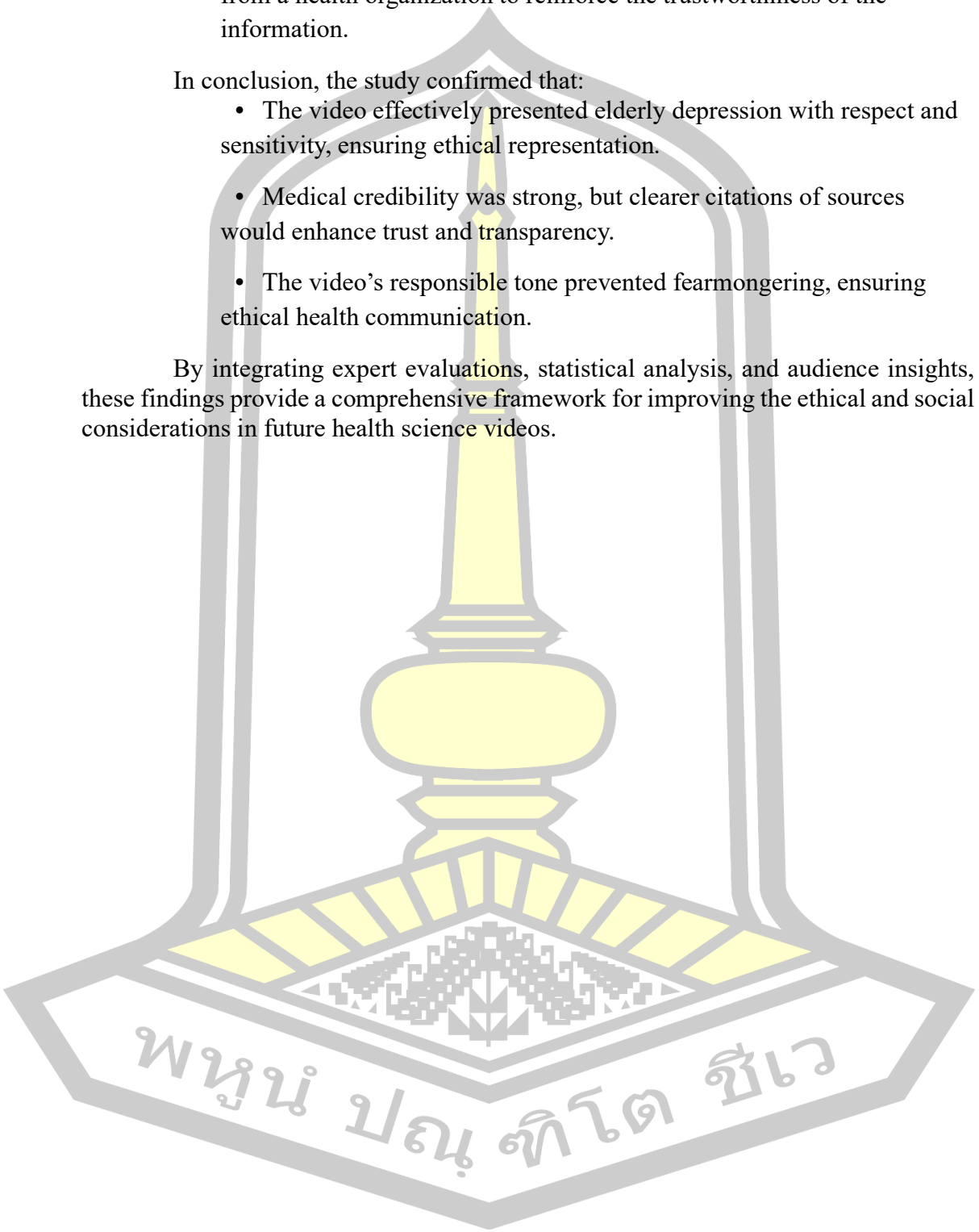
1. Enhancing Transparency in Medical Information
   - Some users requested clearer references to medical literature.
   - Recommendation: Explicitly cite authoritative sources (e.g., WHO, CDC, peer-reviewed studies) within the video to strengthen credibility.
2. Broadening Representation of the Elderly
   - While the video was empathetic and respectful, some users and experts suggested showcasing a wider range of elderly experiences.
   - Recommendation: Incorporate real-life case studies and diverse narratives to ensure more inclusive representation.
3. Strengthening Ethical Health Communication
   - The tone was considered responsible, but a small percentage of users suggested more engagement from medical professionals.

- Recommendation: Include brief expert testimonials or a disclaimer from a health organization to reinforce the trustworthiness of the information.

In conclusion, the study confirmed that:

- The video effectively presented elderly depression with respect and sensitivity, ensuring ethical representation.
- Medical credibility was strong, but clearer citations of sources would enhance trust and transparency.
- The video's responsible tone prevented fearmongering, ensuring ethical health communication.

By integrating expert evaluations, statistical analysis, and audience insights, these findings provide a comprehensive framework for improving the ethical and social considerations in future health science videos.



# Chapter 5

# Conclusion and Future Work

## 5.1 Conclusion

This study explored how short videos can be designed and developed to effectively communicate scientific knowledge about mental health, with a specific focus on depression among aging populations. The research was driven by the central question: How can short videos be designed and developed to effectively communicate scientific knowledge about mental health, particularly depression? To address this, the study pursued two key objectives: (1) To establish a structured methodology for designing and optimizing short videos for science communication related to mental health, and (2) To implement and assess the effectiveness of these optimized short videos on the TikTok platform.

The study contributes to the field by proposing a systematic, data-driven approach to designing short science communication videos, integrating web scraping, machine learning, multimedia learning principles, and empirical user evaluation. The research provides a replicable framework for extracting engagement-relevant insights through natural language processing (NLP) and clustering, using these insights to develop evidence-based storytelling strategies. The approach is further validated through quantitative and qualitative methods, ensuring that the resulting short videos are optimized for engagement, comprehension, and behavioral impact.

A mixed-methods approach was employed, integrating quantitative and qualitative methodologies for a comprehensive evaluation of communication effectiveness. The research process was structured into four key phases. Phase 1 focused on data collection and analysis using web scraping and clustering techniques to extract insights on user engagement with mental health-related short videos. This phase involved gathering and structuring user discussions, content preferences, and engagement patterns from publicly available sources, followed by text preprocessing and k-means clustering to identify key discussion themes. The findings informed the development of core video design elements, including content style, font selection, visuals, background music, color schemes, and video length.

Phase 2 centered on storytelling, applying narrative structures and multimedia learning principles to craft engaging short videos. The study adopted a three-act storytelling model—Introduction, Conflict, and Resolution—to ensure a compelling and emotionally resonant narrative. The Introduction introduced an elderly character experiencing loneliness, establishing the problem of depression in aging populations. The Conflict phase illustrated the emotional and psychological struggles associated with elderly depression, incorporating real-world statistics and factual overlays to enhance credibility. The Resolution phase presented actionable solutions, demonstrating how small interventions—such as family support, medical consultation, and social engagement—can help alleviate depression. These storytelling elements were designed to enhance emotional connection, knowledge retention, and viewer engagement.

Following the storytelling framework, Phase 3 focused on producing and testing the short videos on TikTok, applying findings from the previous phases to

optimize content design. The videos were produced using motion graphics (MG) animation and structured storytelling techniques. Adhering to Multimedia Learning Theory, the videos incorporated clear narration, engaging visuals, and strategically selected background music to facilitate comprehension. The content was then deployed on TikTok, where real-world user interactions—including views, likes, comments, and shares—were monitored over two months. This phase provided empirical validation of how storytelling-driven video design can enhance engagement with mental health content.

Phase 4 implemented pre- and post-test questionnaires and in-depth interviews to assess the impact of the short videos. Participants completed structured surveys before and after watching the videos, measuring changes in user trust, emotional resonance, content preference, interactive behavior, and overall satisfaction. Additionally, expert evaluations were conducted using the Global Quality Scale (GQS) and DISCERN scale, assessing scientific accuracy, credibility, and clarity. Qualitative in-depth interviews were conducted to gain further insights into user comprehension, knowledge acquisition, and engagement preferences.

The study employed purposive and snowball sampling to ensure a relevant participant pool. A total of 363 TikTok users participated in the survey-based study, while 46 participants were selected for semi-structured interviews to explore qualitative aspects of engagement. The web scraping phase also contributed a large dataset of user-generated discussions on health-related short videos, further refining the storytelling approach.

The evaluation results revealed that the storytelling-driven short videos significantly enhanced user trust, emotional engagement, and overall satisfaction. Pre- and post-test comparisons showed substantial improvements in these dimensions, with statistically significant results ($p < 0.001$) and large effect sizes in key engagement metrics. While interactive behavior and user habits showed moderate improvements, qualitative feedback suggested that additional interactive features, such as real-time Q&A or mini-games, could further boost engagement. The study also identified user preferences in video presentation, with viewers expressing a strong preference for MG animation, warm color schemes, and clear voice narration, all of which contributed to higher engagement and comprehension.

From a behavioral perspective, findings indicated that while the videos successfully increased short-term engagement (likes and shares), long-term changes in user habits were less pronounced. Many participants still favored entertainment-focused content over educational videos, suggesting that edutainment strategies—blending education with entertainment—could sustain engagement over time. Additionally, some participants struggled with medical terminology, highlighting the need for simplified language, visual analogies, and expert endorsements to improve content accessibility.

The study also evaluated video presentation and design, confirming that visual appeal, animation quality, and audio clarity played a crucial role in audience retention. The most effective design elements adhered to cognitive load reduction principles, ensuring structured and digestible information delivery. Professional voice-over narration and carefully selected background music significantly enhanced emotional resonance and trustworthiness.

From an ethical and social perspective, expert reviews and audience feedback emphasized the importance of transparent and responsible health communication. While the video was praised for its compassionate portrayal of elderly depression, recommendations were made to incorporate more diverse perspectives and explicit references to authoritative medical sources to further enhance credibility.

In conclusion, this research provides a validated framework for designing and evaluating short-form science communication videos, particularly in the context of mental health awareness. By integrating data-driven storytelling, multimedia learning principles, and real-world user engagement analysis, the study offers valuable insights for educators, health professionals, and content creators aiming to enhance public understanding of mental health. Future research should explore more personalized content strategies, AI-driven recommendations, and interactive engagement techniques to further improve the effectiveness of short science videos. The findings demonstrate that storytelling-based short videos serve as a powerful tool for science communication, paving the way for more engaging, accessible, and impactful health education initiatives in the digital era.

## 5.2 Challenges and Limitations of the Study

### 5.2.1 Balancing Scientific Accuracy and Audience Engagement

One of the key challenges in this study is striking a balance between scientific accuracy and user engagement in short video content. While the research aimed to ensure that mental health information was presented clearly, some users still found medical terms difficult to understand. Oversimplification, on the other hand, could lead to the risk of misrepresenting scientific facts. Achieving both clarity and depth in a short-form video format remains a major obstacle, as the time constraints of platforms like TikTok limit how much detail can be included.

### 5.2.2 Sustained Audience Engagement and Behavioral Change

While the study showed immediate increases in engagement metrics such as likes, shares, and comments, long-term behavioral change was more difficult to achieve. Many users still preferred entertainment-driven content over educational videos, highlighting a challenge in sustaining interest beyond initial exposure. Without personalized engagement strategies, such as adaptive storytelling, gamified interactions, or AI-driven recommendations, the impact of science communication videos may remain short-lived.

### 5.2.3 Platform and Algorithmic Constraints

The study was conducted primarily on TikTok, where the platform's content recommendation algorithm plays a crucial role in determining video reach. This introduces challenges in ensuring that educational videos reach the right audience, as TikTok's algorithm often prioritizes trending and entertainment-focused content over informational videos. Additionally, findings from one platform may not fully translate to others, such as YouTube Shorts or Instagram Reels, limiting the generalizability of engagement trends across different social media ecosystems.

### 5.3 Future Work

The findings of this study provide a strong foundation for understanding how short videos can effectively communicate mental health knowledge, particularly regarding depression in aging populations. However, there are several areas where future research could enhance and expand upon these insights. One of the most promising directions involves the implementation of personalized engagement strategies. The integration of AI-based recommendations, adaptive storytelling, and interactive learning elements could significantly improve user retention and engagement. By leveraging AI-driven algorithms, content can be tailored to individual preferences, ensuring that viewers receive relevant, engaging, and informative videos that align with their interests and behavior patterns. Adaptive storytelling, where narrative structures adjust based on user interaction, could further enhance immersion, making the learning experience more dynamic and personalized.

Another crucial avenue for future exploration is comparative studies across multiple social media platforms. This study focused primarily on TikTok, but short-form video platforms such as YouTube Shorts and Instagram Reels operate with different algorithms, user demographics, and engagement mechanisms. Conducting a cross-platform comparison would provide deeper insights into how audience behavior varies across different digital ecosystems. Understanding these differences could help refine strategies for optimizing educational content delivery on each platform, ensuring that science communication remains effective regardless of the medium.

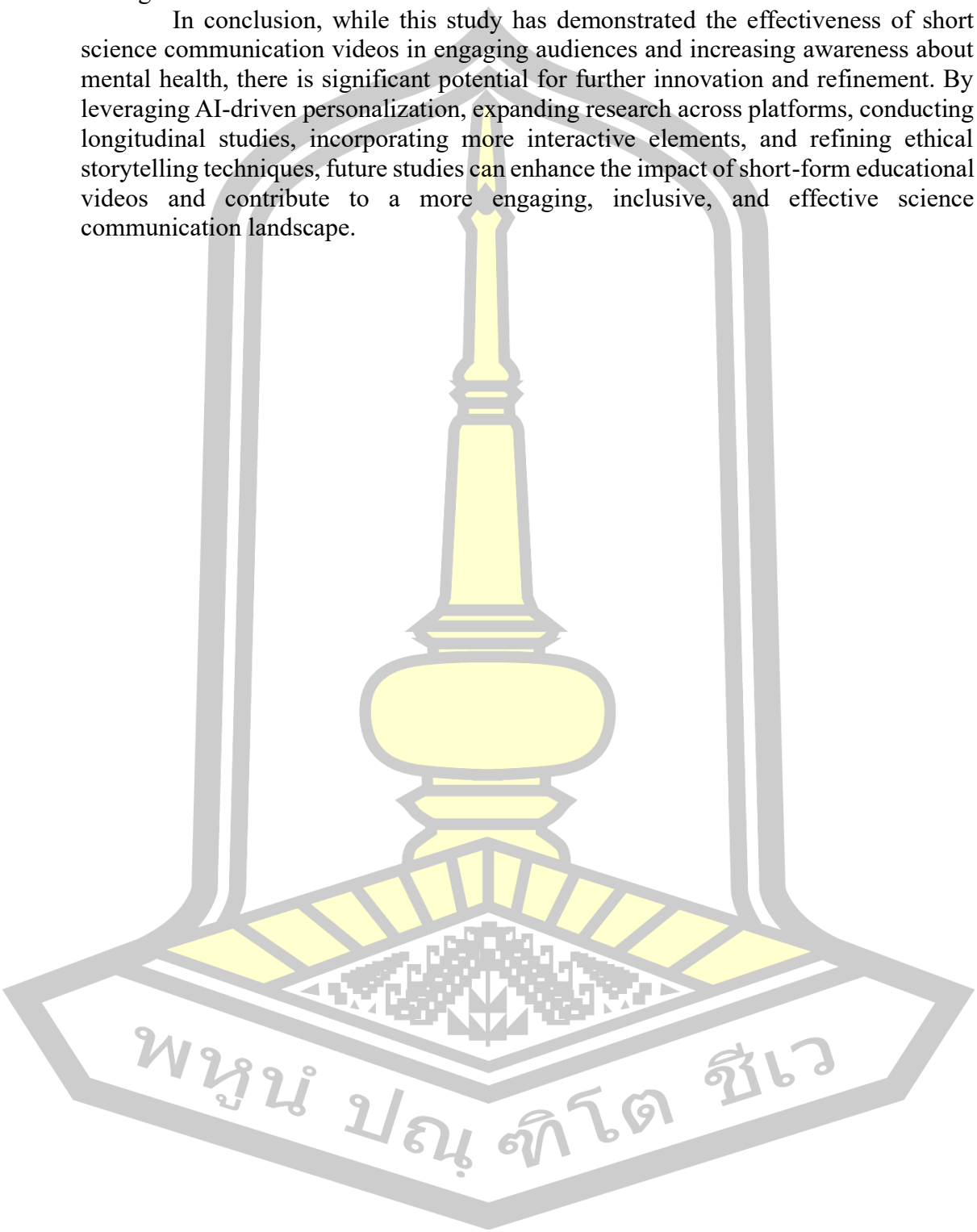
Additionally, longitudinal studies are needed to assess the sustained behavioral impact of short science communication videos. While this research demonstrated short-term improvements in user engagement, emotional resonance, and information retention, it remains unclear whether these effects persist over time. Future studies should implement longer-term follow-ups beyond the initial post-test phase to evaluate whether viewers continue engaging with science-related content and whether their attitudes toward mental health awareness evolve over time. By examining these long-term effects, researchers can better understand the extent to which short-form videos contribute to lasting behavioral change.

Moreover, the integration of more interactive video elements could further enhance user engagement and educational effectiveness. Live Q&A sessions, where users can directly interact with experts, could foster deeper engagement and credibility. Gamification strategies, such as quizzes, challenges, and reward-based interactions, could make learning more enjoyable and encourage continued participation. Additionally, user-generated content contributions—such as allowing viewers to share their own experiences or create response videos — could enhance community involvement and facilitate peer-driven learning experiences.

Finally, future research should delve deeper into ethical storytelling strategies to ensure inclusivity and responsible communication of mental health topics. While this study maintained ethical considerations, further exploration is needed to diversify representation, avoid unintended biases, and enhance accessibility. This includes developing content that resonates with different cultural backgrounds, linguistic variations, and personal experiences, ensuring that mental health messaging is universal, respectful, and empowering. Additionally, incorporating expert endorsements and

evidence-based references within videos can further strengthen credibility and trust among audiences.

In conclusion, while this study has demonstrated the effectiveness of short science communication videos in engaging audiences and increasing awareness about mental health, there is significant potential for further innovation and refinement. By leveraging AI-driven personalization, expanding research across platforms, conducting longitudinal studies, incorporating more interactive elements, and refining ethical storytelling techniques, future studies can enhance the impact of short-form educational videos and contribute to a more engaging, inclusive, and effective science communication landscape.



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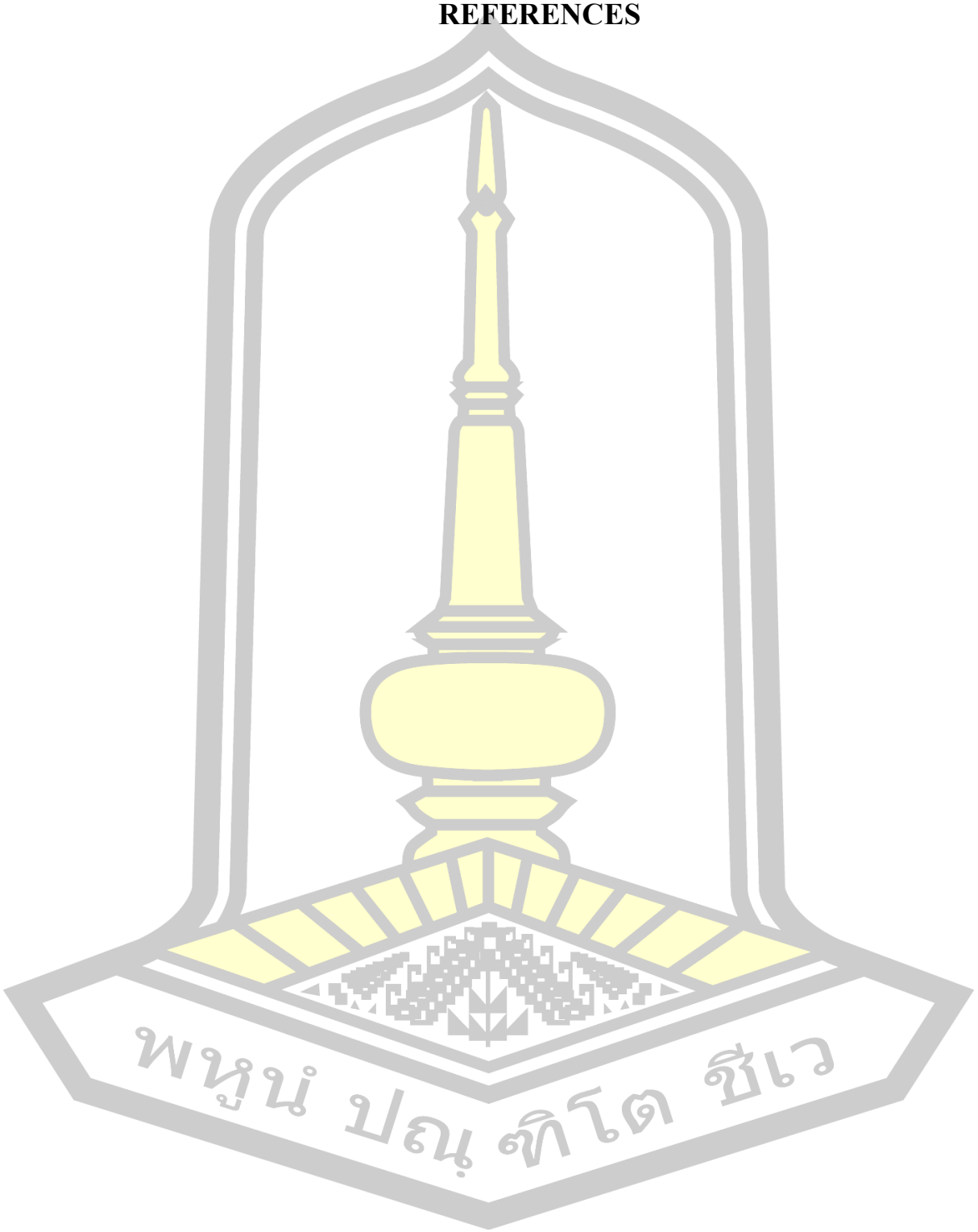

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