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*by* Siti Adlina Rahmiaty

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## BEYOND IMMERSION: A COMPARATIVE ANALYSIS OF 360° AND FLAT VIDEO FOR VENOMOUS SNAKEBITE FIRST-AID EDUCATION

Angelia Lionardi<sup>1\*</sup>, Siti Adlina Rahmiaty<sup>2</sup>

<sup>1,2</sup>Film Study Program, Art and Design Faculty, Universitas Multimedia Nusantara, Jl. Scientia Boulevard, Gading Serpong, Kel. Curug Sangereng, Kec. Kelapa Dua, Kab. Tangerang, Banten 15811, Indonesia

\*Email: [angelia.lionardi@umn.ac.id](mailto:angelia.lionardi@umn.ac.id)

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**Abstract:** As a tropical country, Indonesia is home to numerous snake species, including highly venomous snakes such as the banded krait (*Bungarus fasciatus*) and the Malayan krait (*Bungarus candidus*). Nevertheless, public knowledge of proper first aid for venomous snakebites remains limited, often leading to panic and inappropriate treatment. This study explored the use of MIGUI, a 360° video application, as an educational medium for snakebite first aid. The study involved literature review, documented observation notes, interviews, video production, and usability testing with 30 respondents. Pre-test and post-test questionnaires were used to evaluate participant's prior knowledge, user experience, and understanding after viewing the educational content. The findings indicated that the 360° video provided an immersive viewing experience and encouraged participant engagement. However, the comparison did not demonstrate a clear advantage in knowledge transfer over the flat video format. Technical and presentational factors, including reduced visual clarity, unclear audio, environmental distractions, and users' expectations of interactivity, affected the viewing experience. These findings provide a practical basis for future educational media production by emphasising the need for device-appropriate video resolution, clear audio and subtitles, focused visual composition, explicit interaction guidance, and instructional narratives that direct users' attention towards essential first-aid procedures.

**Keywords:** 360° video application, first aid, usability testing, venomous snakebite

**Abstrak:** Sebagai negara tropis, Indonesia merupakan habitat bagi banyak spesies ular, termasuk ular berbisa tinggi seperti welang (*Bungarus fasciatus*) dan weling (*Bungarus candidus*). Namun, pemahaman masyarakat mengenai pertolongan pertama pada kasus gigitan ular berbisa masih terbatas, sehingga sering menimbulkan kepanikan dan penanganan yang tidak tepat. Penelitian ini bertujuan mengkaji penggunaan MIGUI, sebuah aplikasi video 360°, sebagai media edukasi pertolongan pertama pada kasus gigitan ular berbisa. Penelitian dilakukan melalui studi literatur, dokumentasi, wawancara, pengembangan prototipe, dan usability testing yang melibatkan 30 responden. Pengumpulan data dilakukan menggunakan pre-test dan post-test untuk mengukur pengetahuan awal, pengalaman pengguna, serta pemahaman responden

setelah menggunakan aplikasi. Hasil penelitian menunjukkan bahwa video 360° mampu memberikan pengalaman belajar yang imersif dan mendukung keterlibatan pengguna dalam memahami langkah pertolongan pertama pada gigitan ular. Namun, temuan juga menunjukkan bahwa peningkatan pengetahuan yang dihasilkan belum berbeda secara signifikan dibandingkan dengan video HD konvensional. Faktor teknis dan penyajian, termasuk rendahnya kejernihan visual, audio yang kurang jelas, distraksi dari lingkungan sekitar, serta ekspektasi pengguna terhadap adanya interaktivitas, memengaruhi pengalaman menonton. Temuan ini memberikan dasar praktis bagi pengembangan media edukasi di masa mendatang dengan menekankan pentingnya penggunaan resolusi video yang sesuai dengan perangkat, audio yang jelas dan dilengkapi dengan teks terjemahan, komposisi visual yang terfokus, panduan interaksi yang eksplisit, serta narasi instruksional yang mampu mengarahkan perhatian pengguna pada prosedur pertolongan pertama yang penting.

**Kata kunci:** *first aid, gigitan ular berbisa, penerapan video 360, uji kegunaan*

## INTRODUCTION

Despite the large number of snake species in Indonesia (both venomous and non-venomous), public outreach and education regarding first aid for snakebites remain extremely limited. According to Restutika (2023), literacy on proper first-aid response is crucial, as supported by data collected by Dr. Tri Maharani, M.Si., Sp.EM, a specialist in venomous snake toxicology in Indonesia. She reported approximately 135,000 snakebite cases in Indonesia as of 2021, with a mortality rate of 10%. The actual number is likely higher due to various factors affecting reporting accuracy. One major factor is that many snakebite incidents occur in rural areas where access to hospitals is limited, leading victims to seek traditional treatments instead. Consequently, these cases often go undocumented in official hospital records, resulting in underreporting of the true scale of snakebite incidents (Uyeda et al., 2022). This gap highlights the urgent need for effective and accessible education on first-aid mitigation to improve public response and reduce the risks associated with snakebite cases.

The communities most vulnerable to snakebites are those living in areas with limited access to healthcare facilities, such as regions near forests,

plantations, rice fields, swamps, mining sites, factories, and abandoned buildings (Dafa, 2021). These environments are highly favourable for snakes due to the abundance of hiding places and prey. In addition to individuals who work in these areas, other at-risk groups include firefighters, members of snake enthusiast communities or handlers, and residential security personnel who respond to reports of snake sightings in homes.

First aid for snakebites is generally administered by the victim or bystanders at the time of the incident (NIOSH, 2019). However, due to a lack of accurate information, the measures taken often worsen the victim's condition (Uyeda et al., 2022). People tend to rely on traditional methods such as sucking the wound, burning the affected area, applying herbal remedies, compressing the bite with ice, smearing coffee grounds around the wound, sprinkling salt, or making additional incisions. One of the most common practices is tightly tying the bitten area with a rope or cloth. This method can significantly worsen the condition by cutting off blood circulation, which increases the risk of infection or tissue necrosis (Munawaroh et al., 2024).

Until now, the public has relied on snake-handling communities to teach them how to identify snakes and give tutorials on first aid for snakebites (Parker-Cote & Meggs, 2018). These communities usually attend outreach events (organised by companies, fire departments, housing developers, or other groups) and bring live snakes (both venomous and non-venomous) as part of the session. However, this method carries risks. There is always the possibility that a snake might escape during transport or during the event itself. If the escaped snake is venomous, it could endanger both the community members and the audience. To reduce this risk, the researchers explored how to deliver the same information without direct contact with live snakes. Based on this background, there is a need for a medium that can give people the experience of interacting with venomous snakes in a safe way. One

potential solution is using 360° (360-degree) video, which allows users to explore the content interactively and can serve as a tool for snake education and mitigation.

Previous research indicates that the educational value of 360° video depends not only on immersion but also on attention guidance, technical quality, and alignment between the medium and the learning objective (Evens et al., 2023; Liu et al., 2021). A meta-analysis by Schroeder et al. (2023) likewise found no general learning advantage for 360° video over other instructional formats. Within the Indonesian visual communication context, usability evaluation has also been used to identify user-experience problems and formulate recommendations for improving educational applications (Rahmasari & Yanuarsari, 2017).

However, limited research has examined whether the immersive qualities of 360° video provide clearer knowledge transfer than flat video in the context of venomous snakebite first-aid education. This study addresses this gap through the development and analysis of MIGUI, an educational application that presents venomous snake identification and snakebite first-aid procedures through a 360° video format and compares the resulting knowledge responses with those obtained from a flat video. Therefore, this study aims to analyse the usability and educational application of MIGUI and to compare participants' responses after viewing 360° and conventional versions of the same snakebite first-aid content.

The author chose to feature the Banded Krait (*welang*) and Malayan Krait (*weling*) as the main subjects in the first-aid video because both are highly venomous snakes, yet their populations in the wild remain stable and are not considered endangered. They are classified as Least Concern (LC) on the IUCN Red List (2025). Additionally, *welang* and *weling* snakes are frequently sighted in residential areas, increasing the risk of contact with the

public. This differs from the status of the King Cobra, whose wild population is declining and is currently listed as Vulnerable on the IUCN Red List (2025).

## **METHODS**

This study employed a development-and-evaluation design combining qualitative formative data with descriptive quantitative questionnaire responses. The formative stage involved a literature review and the examination of documented field-observation notes provided by Yayasan Sioux Indonesia (Indonesian snake-handling NGO). Semi-structured interviews were conducted with two experts from the research and education division of Yayasan Sioux Indonesia. Both interviewees, in 2024, were master's students in Biology at Universitas Gadjah Mada whose research concerned venom from venomous snakes of Indonesia. They were also experienced in delivering snakebite first-aid demonstrations in schools. The interviews explored appropriate first-aid responses, common snakebite myths (salt or coffee could repel snakes and that a snakebite wound should be bound tightly), and venomous snake species frequently encountered in both rural environments, such as rice fields and plantations, and urban or residential areas. The interviews were documented through written minutes.

The observational notes and interview findings were used to prepare the outline and instructional narrative of the video. The content was designed to address both common misconceptions and recommended first-aid responses. After the content outline and script had been completed, the video, both 360° footage and conventional flat video, was filmed in Yogyakarta from 27 to 29 July 2024. The 360° footage and the conventional flat-video version were subsequently processed and integrated into an application using Unity to build the interactive application. The resulting

application was named MIGUI, an abbreviation of Mitigasi Gigitan Ular Berbisa or Venomous Snakebite Mitigation. The research procedure is presented in Figure 1.

After video application production, the researchers conducted usability testing with 30 respondents to evaluate participants' immediate knowledge responses to snakebite situations and the usability of the 360° MIGUI application. The evaluation involved 30 Universitas Multimedia Nusantara students aged between 17 and 20 years. The participants came from various regions of Indonesia and represented a general student population rather than occupational or community groups considered to be at high risk of snakebite.

Participants were recruited through convenience sampling. Most participants had previous experience with 360° video or Head-Mounted Display (HMD) devices, primarily through immersive games and films. However, this previous experience did not necessarily involve educational 360° content.

The evaluation was administered by two researchers. Before viewing the video, all 30 participants completed a pre-test measuring their existing knowledge of venomous snakebite first aid. After completing the pre-test, the participants were allocated equally to two groups. Fifteen participants viewed the conventional flat video, while the remaining 15 viewed the 360° video through the MIGUI application. Each group viewed its assigned version of the five-minute educational video. Participants in the 360° group were assisted in wearing and operating the Head-Mounted Display.

Immediately after viewing the video, all participants completed a post-test containing the same first-aid knowledge item as the pre-test. Participants in the 360° group also evaluated their experience of using the MIGUI application. During the sessions, the administrators recorded technical

difficulties and observable problems encountered while participants interacted with the application.

Questionnaire responses were coded according to whether each action was selected or not selected. The frequency and percentage of participants selecting each response were calculated for the pre-test and post-test. Changes in response selection before and after viewing were examined descriptively. Post-test response patterns were also compared between the flat video and 360° video groups. The analysis focused on whether participants selected more of the first-aid actions classified as appropriate after viewing the educational content and whether the response patterns differed between the two video formats.

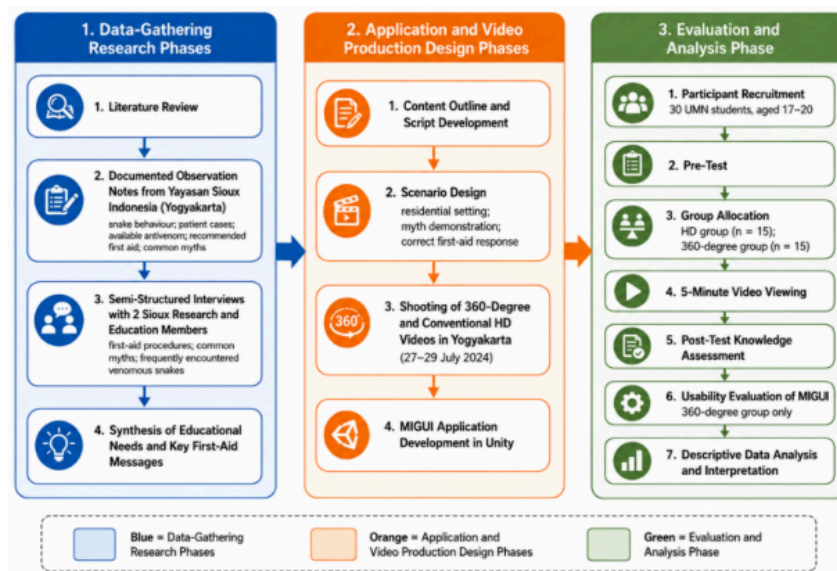


Figure 1. Research Procedural Flowchart  
 Source: Authors' Documentation (2025)

The evaluation did not examine long-term knowledge retention, actual first-aid performance, behaviour during a real snakebite emergency, or clinical outcomes. The study also did not compare either video format with face-to-face instruction delivered by medical professionals or snake-handling

educators. Furthermore, because the participants were university students recruited through convenience sampling, the findings should not be generalised to the Indonesian population, communities with a high risk of snakebite, or trained emergency personnel.

## RESULTS AND DISCUSSION

### Welang Snake and Weling Snake

<sup>1</sup>*Bungarus candidus* (Malayan krait/ blue krait) and *bungarus fasciatus* (banded krait) are two highly venomous *elapid* snakes and are considered medically significant species in Southeast Asia (Rusmili et al., 2014). The Malayan krait, or *weling* snake, is easily identified by its distinctive alternating black and white bands, often with black spots on the white bands. The underside of the body is solid white. It is generally non-aggressive, with slower movements compared to the *welang* (banded krait).

<sup>1</sup>*Bungarus fasciatus*, or *welang* snake is identified by its alternating thick black and white or yellowish bands encircling the body. At a glance, its body characteristics are similar to the *weling* snake. The main difference lies in its V-shaped or triangular head. It is generally passive, but when disturbed, it can deliver a rapid bite (Figure 2).



Figure 2. *Weling* snake (*bungarus candidus*) (left), *Welang* snake (*bungarus fasciatus*) (right)  
Source: Francis, HongKongSnakeID.com (n.d)

Both snakes <sup>12</sup> are highly venomous and possess neurotoxic venom, which attacks the nervous system. Upon being bitten by either species, the victim may initially experience minimal or no symptoms; however, if anti-venom is not administered quickly, the bite may result in death within one to three hours.

### 360° Video

Omnidirectional or 360° (360°) video is a camera format that offers a complete 360° view, allowing audiences to detach from physical reality and enter a digital environment. This makes 360° video both interactive and immersive (Shafi et al., 2020).

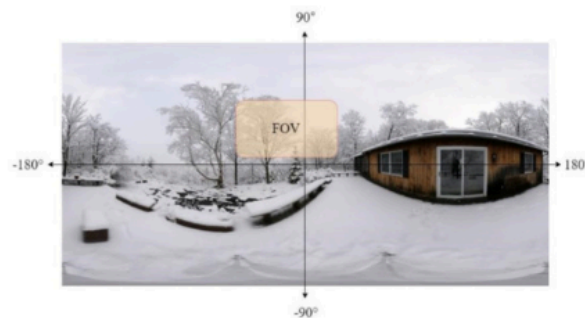


Figure 3. FoV in full 360° video frame  
Source: Shafi et al., (2020)

360° video experiences involve user interaction with the environment through Head-Mounted Displays (HMDs), which present a virtual 360° space surrounding the viewer (Figure 3). The visible portion of the scene, known as the viewport, is determined by the user's head movement while wearing the HMD (Corbillon et al., 2017). The viewport is dynamically tracked, enabling personalised and immersive viewing based on the direction the user is facing.

In designing a 360° video, the author must plan not only the script but also the camera placement and actor blocking (Sneed et al., 2021). This preparation is essential because during shooting, the director must remain in the camera's blind spot and is unable to give real-time directions to the actors.

References for the development of the snakebite mitigation video were taken from the YouTube channels @VirtualSurgery and @The Audio-Visual Suite, particularly the video titled "Orthopaedic Theatres 360° VR Taster" (Figure 4).



Figure 4. Example of 360° video: Orthopaedic Theatres 360° VR Taster  
Source: The Audio-Visual Suite (2017)

In both reference videos, the 360° camera acts as the point of view of a patient undergoing surgery. The video presents how doctors operate, what tools are used, and what the atmosphere is like in the operating room during a procedure. By watching the video, the viewer feels as though they are inside the operating room, observing the situation from the patient's perspective, allowing them to closely follow each person's movement in detail.

### **Development of the MIGUI Educational Content**

The educational content of MIGUI was developed from the literature review, documented observation notes provided by Yayasan Sioux Indonesia, and semi-structured interviews with two members of its research and education division. The preliminary findings indicated that misconceptions about snakebite first aid remained common.

The findings were translated into a five-minute educational scenario situated in a rented residential house. This setting was selected because the interviews indicated that encounters with venomous snakes were not limited to forests, plantations, or rice fields but could also occur in urban residential environments. The domestic setting contained furniture and potential hiding places to represent a plausible snake encounter in an everyday environment.

In this project, the researchers used *weling* snake as the actor because it generally has slower movement and is non-aggressive. Researchers developed a scenario depicting a snakebite victim at home. A friend of the victim seeks help and calls an expert to perform first aid. In the 360° video version, the camera represented the point of view of the snakebite victim, allowing users to observe the incident and first-aid response from within the scenario. The 360° camera was mounted on a helmet worn by the actor playing the victim (Figure 5-6).



Figure 5. Shooting process (left) and video 360° result (right)  
Source: Authors' Documentation (2025)

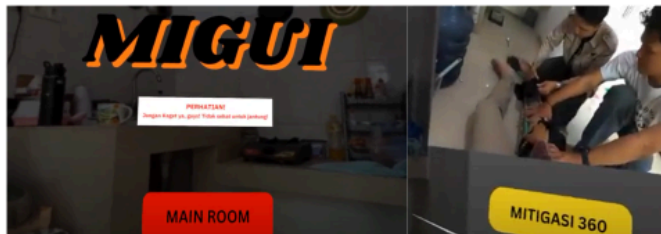


Figure 6. 360° Video Application Interface  
Source: Authors' Documentation (2025)

### Usability Testing

Usability testing was conducted to determine whether the designed product app is easy to use and accessible for its intended users (Figure 7). In this study, the researchers served as the administrators for this usability test. The two administrators were responsible for explaining the purpose of the test and introducing the product to the participants. After the introduction, each respondent was asked to complete a pre-test questionnaire that

measured their initial knowledge regarding first-aid mitigation for venomous snakebites.

The pre-test contained one multiple-response question concerning appropriate first-aid actions following a venomous snakebite. Participants selected a maximum of five responses from a checklist containing both appropriate and inappropriate actions. The post-test contained two components. The first repeated the multiple-response first-aid question used in the pre-test. The second asked participants to report difficulties experienced while viewing the educational content. The usability indicators included audio clarity, visual distractions, application bugs, playback problems, and other difficulties affecting the viewing experience.

The five responses classified as correct in the original study instrument were immobilising the affected limb using a wooden splint (not tightly tied the snakebite wound area), calling an ambulance or the local fire and rescue service, keeping the patient awake, and positioning the bitten area below heart level. These response categories were developed on the basis of the semi-structured interviews with experts of the research and education division of Yayasan Sioux Indonesia but were not subjected to separate formal clinical validation before the evaluation. The instrument measured immediate changes in participants' recognition of the first-aid actions presented in the educational video. It did not measure their ability to perform the procedures in practice.



Figure 7. Usability testing session  
Source: Authors' Documentation (2025)

The pre-test results indicated that misconceptions regarding snakebite first aid were common among the participants. Tightly binding the bitten area with cloth was selected by 22 participants, making it the most frequently chosen response. Contacting an ambulance or the local fire and rescue service was selected by 19 participants, while 10 selected keeping the patient awake. Four participants selected laying the patient down, two selected applying salt to the wound, and one selected applying coffee. Only five of the 30 participants were reported to have selected at least three out of five responses classified as correct and selected no incorrect responses.

Following the pre-test, participants were divided equally into two groups. Fifteen participants viewed the conventional flat video, while 15 viewed the 360° version through MIGUI. Both groups then completed the post-test immediately after the five-minute viewing session.

The descriptive comparison showed both similarities and differences between the two groups. Eight participants in each group selected the response involving immobilisation of the affected limb using cloth and a wooden splint. Contacting an ambulance or the local fire and rescue service was selected by 11 participants in the flat video group and eight participants

in the 360° group. Keeping the patient awake was selected by four participants in the conventional group and six participants in the 360° group.

The misconception involving tight binding remained present after viewing (five participants in the flat video group and seven participants in the 360° group). This practice may worsen the victim's condition by restricting circulation and increasing the risk of tissue damage and potentially leading to necrosis, particularly when maintained for an extended period. These findings suggest that neither video format completely corrected this misconception during the immediate post-test.

| First-aid response                                                          | Pre-test, all participants (n = 30), n (%) | Flat video post-test (n = 15), n (%) | 360-degree video post-test (n = 15), n (%) |
|-----------------------------------------------------------------------------|--------------------------------------------|--------------------------------------|--------------------------------------------|
| Immobilising the bitten limb with cloth and a wooden splint                 | 0 (0.0%)                                   | 8 (53.3%)                            | 8 (53.3%)                                  |
| Tightly binding the bitten area with cloth                                  | 22 (73.3%)                                 | 5 (33.3%)                            | 7 (46.7%)                                  |
| Calling an ambulance or the fire and rescue service                         | 19 (63.3%)                                 | 11 (73.3%)                           | 8 (53.3%)                                  |
| Calling the police                                                          | 0 (0.0%)                                   | 0 (0.0%)                             | 0 (0.0%)                                   |
| Keeping the patient awake and positioning the bitten area below heart level | 10 (33.3%)                                 | 4 (26.7%)                            | 6 (40.0%)                                  |
| Laying the patient down or keeping the patient in a lying position          | 4 (13.3%)                                  | 1 (6.7%)                             | 2 (13.3%)                                  |
| Applying salt to the bite wound                                             | 2 (6.7%)                                   | 1 (6.7%)                             | 0 (0.0%)                                   |
| Applying coffee to the bite wound                                           | 1 (3.3%)                                   | 0 (0.0%)                             | 0 (0.0%)                                   |

Figure 8. Comparison of Participants' Snakebite First-Aid Responses Before and After Viewing the Educational Videos  
Source: Researchers Documentation (2025)

Based on the available aggregated data (Figure 8), the flat video group demonstrated a somewhat higher frequency of selecting emergency referral, whereas the 360° group more frequently selected keeping the patient awake and positioning the bitten area below heart level. The persistence of tight-binding responses indicates that common snakebite misconceptions were not fully corrected by either video format. This finding is consistent with Maduwage et al. (2024), who identified the continued use of harmful pre-

hospital interventions, and with WHO guidance discouraging constrictive practices that may delay appropriate treatment. Future educational media should therefore not only demonstrate the recommended procedure but also explicitly explain why tight binding, salt, coffee, and other familiar practices are inappropriate.

In designing an effective 360° video, both audio and visual quality play a crucial role in ensuring that users can absorb the information clearly. During usability testing, respondents suggested improving the video resolution, as the 4K footage appeared choppy and blurry when viewed through the HMD. It is recommended to use a device-appropriate and optimised video resolution, together with suitable compression settings, to maintain visual clarity while preventing lag and frame drops.

Audio clarity was another concern. Respondents recommended using microphones during filming to improve sound capture. If microphones are not available, adding subtitles is essential to ensure the information is accessible and to minimize distractions during viewing. For instance, several participants reported being distracted by the setting (a residential house) due to unclear dialogue, which affected their ability to focus on the information presented. Additionally, some respondents attempted to interact with the video using the joystick, expecting gameplay-like features, indicating a need to clarify that the video is non-interactive and purely for viewing.

The absence of a clear advantage for the 360° format is consistent with <sup>9</sup> Schroeder et al. (2023), whose meta-analysis found no general learning advantage for 360° video over other formats. The technical and attentional problems observed during the MIGUI evaluation also reinforce the importance of attention-guiding strategies. Liu et al. (2021), found that <sup>15</sup> textual and visual cues can guide attention in immersive video, suggesting that subtitles, verbal directions, simplified environments, and deliberate actor

placement may help ensure that immersion supports rather than competes with the instructional message.

## **CONCLUSION**

This study aimed to analyse the use of MIGUI as an educational application for venomous snakebite first aid and to compare participants' immediate knowledge responses after viewing 360° and flat video versions of the same educational content. The findings showed that the 360° format offered an immersive viewing experience, but the descriptive comparison did not demonstrate a clear advantage in knowledge transfer over the flat video format.

The study contributes to the development of immersive educational media by demonstrating that technological novelty alone does not ensure effective instructional communication. The educational value of 360° video depends on the integration of clear instructional narratives, focused visual composition, intelligible audio, appropriate video resolution, subtitles, and explicit guidance regarding the level of user interaction. In this study, reduced visual clarity, unclear audio, environmental distractions, playback problems, and participants' expectations of game-like interaction affected their viewing experience and may have limited their attention to essential first-aid information. Several limitations should also be acknowledged. The study involved a small convenience sample of university students and did not represent communities with a high occupational or environmental risk of snakebite.

The novelty of this study lies in the development and evaluation of a 360° educational scenario that presents venomous snakebite first aid from the victim's point of view while reducing the need to use live venomous snakes in

public education. The comparison with flat video also provides an initial basis for considering when immersive formats may or may not offer additional educational value.

<sup>7</sup> Future research should involve larger and more diverse participant groups, including residents of snakebite-prone areas and individuals whose occupations increase their exposure to snakes. Further studies should also employ validated first-aid instruments, randomised group allocation, inferential statistical analysis, delayed post-tests, and practical simulations to assess knowledge retention and procedural performance. The production of future 360° educational media should incorporate improved image and sound quality, subtitles, attention-guiding cues, simplified environments, and carefully designed interaction to ensure that immersion supports rather than distracts from the intended learning objectives.

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PAGE 7

PAGE 8

PAGE 9

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PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18

PAGE 19

PAGE 20