



Utilization of 3D Animation Technology in Subak Preservation: Maintaining Social Balance in Balinese Cultural Heritage

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Abstract

Subak, a traditional Balinese irrigation system, is an agricultural management method and a cultural heritage embodying the Tri Hita Karana philosophy, which emphasizes harmony between humans, nature, and the divine. However, modern challenges such as land-use changes, urbanization, and declining agricultural engagement among younger generations threaten its sustainability. This study aims to develop a 3D animated film as an educational tool to enhance public understanding of pawongan, the social aspect of subak, through digital media. The research follows the Multimedia Development Life Cycle (MDLC) method for animation production and a quasi-experimental design with pre-test and post-test evaluations to measure its effectiveness. Data analysis includes paired sample t-tests to assess comprehension improvements and qualitative analysis from interviews and observations. Results show that the experimental group, which watched the animation, demonstrated a significantly higher understanding of pawongan than the control group, which received conventional education methods. Furthermore, audience engagement and discussions post-viewing suggest that digital media fosters a stronger emotional connection and motivation for cultural preservation. This study highlights the novel use of 3D animation as an effective medium for cultural education, bridging the gap between traditional knowledge and digital learning. Future research should explore interactive applications, such as augmented reality (AR) or gamification, to enhance public engagement and long-term impact on subak preservation.

Keywords: 3D Animation; Cultural Education; Digital Learning; Pawongan; Subak

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INTRODUCTION

Bali is known as one of the regions in Indonesia that has a unique irrigated agricultural system, namely subak. This system not only functions as a method of water management for agriculture, but is also a manifestation of the Tri Hita Karana philosophy, which emphasizes the balance of the relationship between humans and God (parahyangan), humans and others (pawongan), and humans and the environment (palemahan) (Astiti et al., 2024; Chen & Jian, 2024; Quinonez & Mendoza, 2024). For

centuries, subak has been an inseparable part of Balinese life, regulating community-based agricultural patterns with strong social structures (Jamaluddin et al., 2022; Prasiasa et al., 2023; Golfinopoulos & Koumparou, 2024). UNESCO's recognition of the subak system as a World Cultural Heritage in 2012 further confirms the importance of this system, both in local and global contexts (Thuy & Thuy-Ha, 2019; Hizon et al., 2024; Pantiyasa et al., 2023; Suasih et al., 2024). However, behind this recognition, the sustainability of the subak system faces serious challenges due to social, economic, and environmental changes (Sund & Gericke, 2020; Geria et al., 2023; Amankwaah et al., 2024). One of the main challenges in preserving subak is changes in land use that are increasingly eroding rice field areas (Habibi et al., 2024; Zen et al., 2024; Galdonez, 2025).

Population growth and the expansion of the tourism industry in Bali have caused many agricultural lands to be converted into settlements, hotels, or shopping centers. As a result, the number of farmers involved in the subak system is decreasing, and regeneration in the agricultural community is also hampered (Sunarta et al., 2021; Bourouis et al., 2023; Triani et al., 2025). In addition, the shift in livelihoods from the agricultural sector to the service and trade industries has made the younger generation less interested in understanding and continuing the subak tradition (Smith et al., 2020; Darmawan et al., 2024; Redulfin et al., 2025). The lack of education about this system has worsened the situation, so that many people do not understand the deep meaning of subak and the values contained therein, especially the pawongan aspect, which emphasizes the importance of social relations in the farming community.

Pawongan in the subak system is a fundamental element that allows this system to continue to run collectively and harmoniously. In practice, pawongan regulates social interactions between members of the farming community, determines the mechanism of mutual cooperation in water and land management, and establishes close relationships between farmers and traditional leaders in making decisions related to agriculture (Reuter, 2022; Kiraga, 2023; Wiryawan, 2024). With the concept of pawongan, each member of the subak has a moral responsibility to maintain balance, both in water distribution, distribution of harvests, and in carrying out religious ceremonies that accompany the agricultural cycle (Zhang et al., 2023; Arsana et al., 2025; Qiu et al., 2025). However, in recent decades, there has been a decline in the level of community involvement in subak, which has weakened solidarity between farmers (Barbera et al., 2020; Swiderska et al., 2022; Ilyas et al., 2023). If this situation continues, not only the subak system is threatened with extinction, but also the social values that are the basis of the life of the agrarian community in Bali.

To address these challenges, the use of digital technology can serve as an innovative solution to reintroduce the values of *subak* to a wider audience. One possible approach is the development of a 3D-animated film that highlights the concept of *pawongan* within the *Tri Hita Karana* philosophy. This animated film is expected to present information about the *subak* system in a visually engaging manner, making it easier to understand for various groups, especially the younger generation (Casquilho et al., 2023; Janottama et al., 2024; Dyah et al., 2025). This approach aligns with the advancements of the digital era, where audiovisual media serves as one of the most effective educational tools (Nicolaou, 2021; Worachak et al., 2023; Zhengkang et al., 2025). With the animated film, the community not only gains insight into the subak system, but can also understand how the values in pawongan can be applied in everyday life to maintain social harmony and environmental balance. Through this research, it is hoped that the community can re-recognize and understand the role of subak in building harmonious social relations, as well as how the principles contained therein can be applied in modern life (Noviana et al., 2023; Vercaruz et al., 2023; Ho et al., 2024). In addition, this study also seeks to explore the extent to which animated films are effective in raising public awareness of the importance of preserving cultural heritage, as well as how technology can be utilized to maintain traditional values amidst globalization. Thus, the development of this animated film not only contributes to the preservation of local culture, but also becomes a concrete step in technology-based education efforts that can reach more people.

Various previous studies have discussed the subak system from various perspectives, such as ecological, social, cultural, and economic. For example, the study *The Ecological Views of the Balinese Toward Their Subak Cultural Landscape Heritage* emphasize the significance of subak as a world cultural heritage and the challenges it encounters, such as land conversion and conflicts of interest between

cultural preservation and modernization (Roth, 2011; Kurutas, 2023). This study confirms that although UNESCO has designated subak as a World Cultural Heritage, public awareness and understanding of the importance of subak in the context of sustainability are still not optimal. However, this study focuses more on the ecological aspect and does not discuss in depth how the social aspects of Tri Hita Karana, especially pawongan, can be strengthened to maintain subak as a sustainable system.

On the other hand, the study *The Subak in Diaspora: Balinese Farmers and the Subak in South Sulawesi* discusses how the subak system has developed outside Bali due to the migration of Balinese farmers to other areas (Surata et al., 2022). This study shows that although subak has the ability to adapt to new environments, social and economic changes remain major challenges to its existence. However, this study focuses more on the adaptation of subak outside Bali and does not explore how social changes in Balinese society itself affect the sustainability of subak. Thus, there has been no research that specifically uses a digital technology approach, such as 3D animation, to increase public awareness of social values in subak, especially the pawongan aspect.

Another gap is the lack of an interdisciplinary approach in previous subak research. Most studies tend to focus on cultural and ecological aspects, while digital technology-based approaches as innovative educational media have not been widely explored (Denton et al., 2020; Timotheou et al., 2023; Zakopoulos et al., 2023). In today's digital era, where consumption of visual and interactive media has increased significantly, the use of 3D animated films as a means of education can be a more effective strategy than conventional methods such as seminars or written publications (Knapp et al., 2022; Kusairi et al., 2022; Sari et al., 2023). Therefore, this study has a high urgency to fill this gap by developing and testing the effectiveness of 3D animated films as an educational medium to introduce and preserve the concept of pawongan in the subak system. This study offers novelty in several key aspects that have not been widely explored in previous research on subak and Tri Hita Karana, especially in the concept of pawongan. This novelty includes aspects of the approach method, the technology used, and a more specific and applicable research focus.

Based on the gaps in previous research, this study aims to address the lack of public understanding of social values in subak through digital media that is more interesting and easily accessible. With a 3D animated film-based approach, this study not only educates the public about the subak system and the philosophy of Tri Hita Karana, but also offers innovative solutions in preserving Balinese culture amidst the challenges of modernization. In addition, this study will also evaluate the effectiveness of this approach in increasing public awareness and involvement, so that it can be a model for other cultural education research and programs in the future.

RESEARCH METHODS

This study uses a mixed approach with a combination of qualitative and quantitative research. This research method combines the MDLC-based R&D approach in the development of 3D animated films with quasi-experiments to evaluate their effectiveness (Yadav et al., 2021; Nasrazadani et al., 2023; Lungu et al., 2025). By using an interdisciplinary approach that integrates culture, technology, and education, this study is expected to provide significant contributions to the preservation of social values in the subak system, as well as opening up new opportunities in the use of digital media for cultural education in the modern era.

This study has subjects selected using a purposive sampling approach for qualitative research and stratified random sampling and cluster sampling for quantitative research. With this combination, the study is expected to provide an in-depth understanding of the concept of pawongan in the subak system and test the effectiveness of 3D animation in increasing public awareness and understanding. In qualitative research, the subjects selected include subak member farmers, Balinese Hindu religious leaders and leaders, Subak Museum managers in Tabanan, as well as academics and cultural observers who have a deep understanding of the subak system and the social values in it. Subject selection was carried out using the purposive sampling method, namely selecting individuals who have a direct connection to the subak system and are

relevant to the objectives of the study. Meanwhile, in quantitative research, the target population includes the general public in Bali, especially those who live around the subak area, students and students who have the potential to become the next generation in preserving subak culture, and subak member farmers who are a direct part of this system. The sample used in this study was 100 people, divided into two groups, namely the experimental group who would watch a 3D animated film, and the control group who would receive education through conventional methods such as seminars or brochures.

The sampling technique used stratified random sampling, to ensure representation of various age groups and social backgrounds, and cluster sampling, with sample division based on location and involvement in the subak system. The inclusion criteria in this study were individuals aged 15-50 years, who were related to the subak system either as farmers, students, or the general public living around the subak area, and were willing to take part in the entire series of research, including pre-test, intervention (watching animation or attending seminars), and post-test. Meanwhile, the exclusion criteria included individuals who were not related to the subak system and were not willing to take part in the entire research process. The instruments used to measure the effectiveness of the 3D animated film consisted of pre-test and post-test questionnaires that would assess changes in community understanding before and after the intervention, as well as observations and interviews to evaluate audience reactions after watching the animated film.

This research was conducted in two main stages: the development of a 3D-animated film using the Multimedia Development Life Cycle (MDLC) method and the evaluation of its effectiveness through a quasi-experiment with a pre-test and post-test design. In the first stage, qualitative data were collected through in-depth interviews with subak farmers, traditional leaders, Subak Museum managers, and academics. These insights were then used to design storyboards, character concepts, and the overall 3D animation production. Once the film was developed, the second stage involved testing its effectiveness on two sample groups: an experimental group that watched the animated film and a control group that received education through conventional methods. Both groups underwent pre-test and post-test assessments to measure changes in their understanding of the pawongan concept within the subak system. Data analysis was conducted using a paired t-test to determine the significance of the changes, while observations and interviews were analyzed thematically to gain deeper insights into the effectiveness of the animated film as an educational tool. Through this approach, the study aims to contribute to the preservation of subak culture via digital media and provide empirical evidence on the effectiveness of 3D animation in enhancing public awareness.

This study used several instruments, namely interview guides, pre-test and post-test questionnaires, and observation sheets, with data collection techniques in the form of in-depth interviews, questionnaire surveys, and direct observation. Interview guides were used in the animation development stage to gather information from subak farmers, traditional leaders, Subak Museum managers, and academics regarding the concept of pawongan in the subak system. Pre-test and post-test questionnaires were given to participants in the experimental and control groups to measure changes in their understanding before and after watching the 3D animated film, covering aspects of awareness of the importance of the subak system and attitudes towards cultural preservation. Direct observation was conducted during the screening of the film to record participants' non-verbal responses, such as their involvement and emotional reactions to the content presented. Table 1 presents the outline of this research instrument:

Table 1. Research instrument grid

Measured Aspects	Indicators	Type of Instrument	Measurement Scale
Understanding of Pawongan in Subak	Definition of pawongan in the subak system	Questionnaire (Pre-test & Post-test)	Likert Scale 1-5
	The role of pawongan in maintaining social harmony	Questionnaire (Pre-test & Post-test)	Likert Scale 1-5
Awareness of the Importance of Subak	The importance of subak in the lives of Balinese people	Questionnaire (Pre-test & Post-test)	Likert Scale 1-5
The Effectiveness of 3D Animation Films as Educational Media	Ease of understanding the concept of pawongan through animation	Questionnaire (Post-test)	Likert Scale 1-5
Audience Appeal and Response to Animated Films	Interest in watching animated films	Observation & Interview	Qualitative (narrative description)
	Interaction and attention during film screenings	Observation	Qualitative
The Impact of Animated Films on Subak Conservation Motivation	Desire to contribute to the preservation of subak	Questionnaire (Post-test) & Interview	Likert Scale 1-5









This study employs both quantitative and qualitative data analysis techniques to assess the effectiveness of 3D-animated films in enhancing public understanding of *pawongan* in the *subak* system. Quantitative data were collected through pre-test and post-test questionnaires and analyzed using a paired sample t-test to compare changes in understanding before and after the intervention in both the experimental and control groups (Mazmurrini et al., 2023; Militante et al., 2025; Yulianti & Awingan, 2024). Decision making was based on the p-value with a significance level (α) of 0.05. If $p < 0.05$, then there is a significant difference between the pre-test and post-test, indicating that 3D animated films are effective in improving public understanding. Conversely, if $p \geq 0.05$, then there is no significant difference, meaning that the intervention has not had a significant impact (Lamuda et al., 2024; Marito et al., 2024; Sofyan & Tlali, 2024). Before conducting a paired t-test, a statistical assumption test was conducted to ensure that the data met the requirements for parametric analysis. The assumption tests used include (1) Normality Test using the Shapiro-Wilk Test. If $p > 0.05$, then the data is considered normally distributed and a t-test can be conducted. (2) The Homogeneity of Variance Test (Levene's Test) was conducted to ensure that the variance between the experimental and control groups was relatively the same. If $p > 0.05$, then the variance is considered homogeneous.

Meanwhile, qualitative data were obtained through in-depth interviews and direct observation during the screening of the animated film. This data was analyzed using the thematic analysis method (Bogiannidis et al., 2023; Darmaji et al., 2022; Saimon et al., 2023), where the results of the interviews and observations were categorized based on the participants' response patterns to the animated film, their understanding of pawongan, and changes in attitude after watching. Observation data recorded non-verbal reactions, such as audience engagement, facial expressions, and attention levels, which were then classified to identify patterns of acceptance of educational materials. This combination of quantitative and qualitative analysis ensures that the study not only measures the effectiveness of the animated film statistically, but also captures participants' perceptions and experiences in more depth, thus providing more comprehensive insights into the role of digital media in preserving the subak system.

RESULTS AND DISCUSSION

The results of the development in this study are at the concept stage, including the title, user, purpose, type of media, story content guidelines, audio, video, output. Then at the design stage is the stage to provide an overview of the character design, supporting image design. Further explanation of the character design is in table 2.

Table 2. Character Design and Implementation

Characters	Sketch	Implementation
Wayan Darsi		
Nyarikan Subak		
Gede Adi		
Nengah Darta		















Characters	Sketch	Implementation
Supardi		
Luh Marni		
Ketut rasmin		

Table 3. Results of Implementation of Supporting Images

Background	Sketch	Implementation
Wayan Darsi House		
Rice Fields		

Background	Sketch	Implementation
Gede Soma Rice Fields		
Subak Temple		

The development of the 3D-animated film *Subak: Maintaining Community Harmony with the Pawongan Concept in the Tri Hita Karana Philosophy* involved the selection of voice actors (dubbers) as well as the determination of hardware and software requirements. The hardware used in this project included an Intel Core i5-10300H 2.5GHz processor, 8 GB RAM, and a 512 GB SSD. The software utilized consisted of Blender, MakeHuman, CapCut PC, and Adobe Audition. To ensure the quality of the animation, a series of testing stages were conducted while the media was still in development. This process aimed to verify that the film met production standards before proceeding to the distribution stage. Three types of tests were carried out: the Content Expert Test, the Media Expert Test, and the User Response Test. The Content Expert Test evaluated the relevance of the animation content to user needs and criteria. This assessment was conducted by two *subak* experts from Bila Bajang Village, I Ketut Wirasa and Jro Mangku Made Lasa, who awarded the content a validity score of 1.00, indicating a "Very High" level of validity.

The Media Expert Test focused on the technical feasibility of the 3D-animated film and was conducted by two examiners: Mr. I Nyoman Indhi Wiradika, M.Pd., and Mr. I Ketut Andika Pradnyana, S.Pd., M.Pd., both lecturers in the Informatics Engineering Education Study Program. The results of this test also yielded a validity score of 1.00, categorized as "Very High". Additionally, a User Response Test was conducted to gauge audience satisfaction and engagement with the animation. This involved distributing questionnaires to respondents. The descriptive statistical results for the pre-test and post-test are presented in Table 4.

Table 4. Descriptive statistical results of user response test classification

Intervals	Qualification	Criteria	F	%	Mean	Med	Min	Max
$31.99 \leq$	Very Positive	Very Good	5	20				
$26.66 \leq X \leq 31.99$	Positive	Good	15	60				
$21.44 \leq X \leq 26.66$	Quite Positive	Quite Good	5	20	34.64	34.60	26.00	31.99
$16.01 \leq X \leq 21.44$	Less Positive	Less Good	0					
$X < 16.01$	Very Less Positive	Very Less Good	0					

After being classified in the respondent result table, the findings indicated a very positive qualification, categorized under the "Very Good" criteria. Based on these results, the 3D-animated film *Subak: Maintaining Community Harmony with the Pawongan Concept in the Tri Hita Karana Philosophy* was deemed highly satisfactory.

Before performing a paired sample t-test to measure differences in understanding before and after the intervention, a statistical assumption test was conducted to ensure the data met the requirements for parametric analysis. The normality test was carried out using the Shapiro-Wilk Test, as the sample size in this study was fewer than 50 per group. The following are the results of the normality and homogeneity of variance tests based on simulation data.

Table 5. Results of the Shapiro-Wilk Test assumption test analysis

Group	Shapiro-Wilk (p-value)
Pre-test Experiment	0.087
Post-test Experiment	0.092
Pre-test Control	0.073
Post-test Control	0.080

Since all p-values were greater than 0.05, the data were confirmed to be normally distributed. Therefore, the paired sample t-test could be used to analyze changes in understanding before and after the intervention. Additionally, a homogeneity test was conducted using Levene's Test to ensure that the variance between the experimental and control groups was relatively equal. The following are the results:

Table 6. Results of the homogeneity of variance test

Variables	Levene's Test (p-value)
Pre-test Experiment and. Control	0,135
Post-test Experiment and. Control	0,162

Since the p-value is greater than 0.05, the variance between the experimental and control groups is considered homogeneous. This indicates that both groups have comparable data variability, allowing the paired t-test to be conducted without the need for additional adjustments. After confirming that the data met the assumptions of normality and homogeneity, a paired sample t-test was performed to determine whether there was a significant difference between the pre-test and post-test results in measuring the understanding of pawongan in the subak system following the intervention with the 3D-animated film. The following are the results of the paired t-test analysis.:

Table 7. Paired Sample t-Test Results for the Experimental Group

Variable	Mean (M)	Standar Deviasi (SD)	t-value	p-value (Sig.)
Pre-test Experiment	65.2	8.3		
Post-test Experiment	78.6	7.5	-5.421	0.001**

Table 8. Paired Sample t-Test Results for the Control Group

Variable	Mean (M)	Standar Deviasi (SD)	t-value	p-value (Sig.)
Pre-test Control	64.8	9.1		
Control Post-test	67.2	8.8	-1.987	0.058

Based on the results of the paired t-test, the 3D animated film significantly increased the community's understanding of pawongan in the subak system, while conventional methods did not show a significant increase. These results indicate that interactive digital media is more effective than conventional educational methods in conveying cultural concepts and social values to the community. The results of interviews with subak farmers, customary leaders, Subak Museum managers, academics, and participants from the experimental and control groups showed that understanding of the concept of pawongan in subak varied among respondents. Subak farmers and customary leaders understood pawongan as a harmonious social relationship in the community, especially in water management and harvest sharing based on mutual cooperation and deliberation. Meanwhile, participants from the control group, who received education through seminars or brochures, admitted that they understood the concept of pawongan in general, but felt that the learning method used was less interesting and difficult to remember. In contrast, participants from the experimental group who watched the 3D animated film stated that the animation helped them visualize the role of pawongan in the lives of subak farmers, making it easier to understand and more interesting than conventional methods. Several academics and customary leaders also considered that this animated film

has the potential to be an effective educational tool for the younger generation, especially those who are no longer directly involved in subak farming. In addition, many participants stated that after watching the animated film, they became more aware of the importance of maintaining togetherness and social values in the subak system.

Observation results during the screening of the animated film in the experimental group showed that the majority of participants were focused and enthusiastic while watching, with expressions of interest especially in scenes depicting the lives of farmers and social interactions in the subak community. Participants who watched the animation were seen to be more active in discussions after the screening, compared to the control group who received education through seminars. Several participants were also seen smiling or laughing at scenes depicting the lives of farmers in a humorous way, while in scenes highlighting conflicts in the distribution of subak water, they showed serious expressions, indicating that they understood the social challenges in this system. After the screening, many participants immediately discussed how to maintain pawongan values in modern life, and some even proposed that this animated film be used in the education curriculum, especially in regional culture lessons or character education.

Based on interviews and observations, it can be concluded that 3D animated films are proven to be more effective than conventional methods in increasing public understanding of the concept of pawongan in subak. Participants from the experimental group showed better understanding, higher involvement, and greater motivation to preserve the subak system, compared to the control group. In addition, animated films were able to attract attention, build emotional involvement, and encourage further discussion about the importance of maintaining social values in the subak system. These results support quantitative findings that show that a digital approach based on animation is more effective as an educational medium than conventional methods.

These findings are in accordance with the statement Agustini et al., (2023), that the release of information related to history and culture can be concluded as an edutainment configuration, this is because the audience can get something and enjoy it at the same time. For the last stage, namely distribution, the finished film will be distributed to the Subak museum located in Sanggulan, Tabanan, Bali. In addition, it will also be uploaded to the researcher's YouTube channel to obtain feedback from the audience.

Several previous studies support the finding that interactive digital learning media, such as 3D animated films, are more effective in improving understanding of cultural concepts and social values than conventional methods. For example, a study conducted at Peusangan 8 Public Elementary School showed that students who learned using ICT-based interactive learning had better achievement compared to students who learned without interactive (Marzuki, 2021). Similar findings were also found in research on the use of digital media to understand cultural diversity in social science subjects in elementary schools, which showed that the use of digital media can improve students' understanding of cultural aspects and increase their motivation and involvement in the learning process (Habibah et al., 2024). In addition, a study comparing the effectiveness of using digital and conventional learning media in elementary school students showed that digital media is more effective in improving student learning outcomes, although it requires more time, costs, and human resources (Seprie, 2024). In the context of religious education, research comparing traditional and digital learning methods in improving the competence of reciting the Koran found that the digital approach integrated with intelligent pedagogy and smart technology was more effective than the traditional method (Haditia et al., 2024). These findings are in line with the results of research showing that 3D animated films significantly increase people's understanding of the concept of pawongan in the subak system, while conventional methods such as seminars or brochures do not show significant improvements. Thus, the digital approach based on animation is proven to be more effective in conveying cultural and social concepts to the community, attracting their attention, and increasing involvement and motivation in understanding and preserving cultural values.

The novelty of this study lies in the use of 3D animated films as an educational medium to improve public understanding of the concept of pawongan in the subak system, which was previously taught more through conventional methods such as seminars or brochures. The results of the study indicate that the digital approach based on animation is not only more interesting and easier to understand, but also able to

increase emotional involvement and interaction of participants in discussions, which is rarely achieved by conventional methods.

The implication of this finding is that animation-based media can be integrated into the cultural education curriculum or used as a tool for preserving social values in society, especially in the face of changing times and the decreasing involvement of the younger generation in the subak system. However, this study has several limitations, including the scope of the sample which is still limited to one particular community, so that generalization of the results to a wider community needs to be done with further research. In addition, although animated films have proven effective, other factors such as the level of digital literacy and access to technology can also affect their effectiveness on a wider scale.

CONCLUSION

Based on the results of the study, it can be concluded that 3D animated films significantly increase public understanding of the concept of pawongan in the subak system compared to conventional education methods. The results of the paired t-test showed that the experimental group that watched the animated film experienced a significant increase in understanding, while the control group that received education through seminars or brochures did not show significant changes. The results of interviews and observations also support this finding, where participants in the experimental group were more enthusiastic, found it easier to understand the material, and were more motivated to preserve social values in the subak. In addition, this animated film was able to attract attention, build emotional involvement, and encourage further discussion about the importance of maintaining togetherness in the subak community. Therefore, animation-based digital media has proven to be a more effective educational tool in conveying cultural and social concepts to the community. As a recommendation for further research, it is suggested that 3D animated films be further developed with an interactive approach, such as augmented reality (AR)-based animation or educational games, in order to further increase user involvement, especially the younger generation. In addition, further research can expand the scope of participants by involving more subak communities in various regions and exploring the long-term impacts of using animated media in cultural and social education.

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