

FILM TRANSFORMATIONS FROM ANALOG TO DIGITAL: A CASE STUDY OF FILM RESTORATION IN INDONESIA

Rizki Briandana^{1*}, Nindyta Aisyah Dwityas², Bambang Joko Priyono³, Salsabilla Audinna⁴

^{1,2,3}Universitas Mercu Buana, Jakarta, Indonesia, ⁴Universitas Padjadjaran, Bandung, Indonesia.

Email: ^{1*}rizki.briandana@mercubuana.ac.id, ²nindyta.aisyah@mercubuana.ac.id, ³bambang_jp@mercubuana.ac.id, ⁴salsabillaudinna@gmail.com

Article History: Received on 20th August 2019, Revised on 19th November 2019, Published on 16th January 2020

Abstract

Purpose of the study: The purpose of this research is to analyze how the innovations are done in the film restoration process because each celluloid film has a different character.

Methodology: Methodology in this research is a case study by using data collecting technique of interview and observation.

Main Findings: The research results obtained that the film restoration process is able to meet the standardization of broadcast-quality on television.

Applications of this study: Primary data in the research comes from an interview with six informants. Each of the informants is a practitioner who is engaged in film restoration, from the production manager, head of the restoration, head of the film laboratory, film scanning, and film editor.

Novelty/Originality of this study: The digitalization is an innovation that has to be developed to save films and documentaries with high historical values so that each generation can learn and know the history of events that had occurred in the past.

Keywords: *Film Transformations, Restoration, Analog, Digital, Innovation.*

INTRODUCTION

The development of cinema has brought many changes, not only in daily life but also in changing the point of view for those who witness it (O'Connell, 2010). The old films that are in the process of making them went through many processes and were associated with celluloid film (Larry, Rosenberg, & Uhler, 1980).

Today's technology in the cinema has changed in many viewpoints, especially the social world (Dixon & Zonn, 2004). The social world and the film can be said to be close to each other because without any social or historical issues that occur then the resulting film also does not exist. Many of the current Indonesian films are not far away from an issue and history (Briandana & Dwityas, 2018). This is because the historical value of a movie is very important. In other countries like Malaysia and Singapore, they are willing to spend more money to make a film that has historical values (Setijadi-Dunn & Barker, 2010).

In Indonesia, there is a problem in storing old film materials in the forms of celluloid (Barker, 2011). First is the way of storing film materials that require the room temperature that must be adjusted with the materials of the film. Second is the climate of a country which can also damage film tapes so that storing the materials of the film must be adapted to the characteristics of the existing celluloid film tapes (Setijadi-Dunn & Barker, 2010).

The emergence of computer technology in the 1970s brought changes not only in the world of the manufacturing industry but almost in every system of the world economy (Cave, 2008). Intended in the development of television broadcasting which originally television can only be broadcast with frequency signals but now television can be broadcast with digital waves or what is also called Bit. Bit waves are actually low-frequency waves or what is known as the digital frequency wide-band radio frequency spectrum band is 1: 6 (Wallmüller, 2007).

The current technological developments solve the problem of storing celluloid film tapes. On August 11, 2010, the process of digitizing the old films was conducted for the movie "Tiga Dara" (1956). This film becomes a public spotlight especially in Indonesia because this film is shown with 4K-movie format (4096 x 3112 pixels per frame). In the process of collecting the "Tiga Dara" film tape material, the film tape is damaged by the parasite mushrooms, the shrinkage of size and the tear of film tape. The "Tiga Dara" movie restoration process takes up to 17 months and costs up to 260 euros for the restoration process from material preservation to digital restoration.

Through this data, the researcher wants to explain how an analog and digital process can also run on the process of digitizing the film, which is then broadcast through digital waves on pay television. The definition of analog in film transformation is how a celluloid tape or tape is cleaned and has undergone a process of checking material whether there is significant damage to each part of the shoot or known as Preservation (Flueckiger, 2012). While the definition of digital transformation film explains how each material that has been cleaned and physically checked is then scanned for subsequent restoration processes with the aim of simulating damage to the celluloid film band so that the celluloid film tape that has undergone the scanning process can be repaired (Wallmüller, 2007). The digitization process is also known

as the film restoration process. This process is also in line with previous research explaining changes in analog and digital films, as well as the advantages and disadvantages of analog and digital changes ([Cave, 2008; Mattock, 2010](#)).

Restoration brings a new wave in the process of digitizing old film materials, where its application is still very rare in Indonesia ([Barker, 2011](#)). On the other hand, old movies have messages that can be used as learning tools for the next generation hence old films have very strong historical values ([Amir, 2012](#)). From an industry point of view, old movies have their segmentation to broadcast and have economic value in the film and television industry in Indonesia ([Morissan, 2016; Soesastro, 1998](#)). The development of social media also has an important role to introduce to the audience on the development of existing film restoration ([Dwityas, 2016](#)).

Based on the background, the purpose of this study is to analyze how a process of digitizing movies from analog to digital in old movies and how technological innovation is able to change the point of view in film restoration to become a new selling point in the film and television industry in Indonesia.

The significance of this study is related to the importance of the process of restoration of analog films. What is done by film companies in Indonesia with various challenges such as climate problems, knowledge, and technological limitations can be used as valuable references for film restoration solutions?

LITERATURE REVIEW

Restoration Film

Damage that occurs in the film cannot be stopped but there is a way to slow down the process, which is to preserve it. If the damage is already severe, the steps that need to be taken are to carry out a restoration. [Enticknap \(2013\)](#) considers film restoration is not new. Basically, film restoration creates the experience of watching a film that results from restoration, such as the experience of watching the original film.

[Read & Meyer \(2000\)](#) stated that a film restoration is a form of duplication. Film restoration aims to save the film results of the restoration. This copying uses the original film as a source of restoration; as a result, each of the duplication activities will affect the original film because of exposure to chemicals. Maintaining film storage conditions is also important to increase the life span of the film as long as possible. But it cannot be denied that one day the film will degrade and can only be saved through restoration. Another powerful way to preserve these films is to convert the results of restoration into modern film stock. Many films that were produced several years to decades ago have lost track records. If it still exists, it is rarely in a well-maintained condition. Some are caused by economic reasons (films are ignored or destroyed because they are already unprofitable), practical reasons (wanting to use space intended to store stacks of the film), and aesthetic reasons (old films are considered 'primitive' for increasingly 'sophisticated' films). Even without human negligence and interference, films can self-destruct. Over time the film will decompose due to chemical compounds contained in the film content is unstable ([Read & Meyer, 2000](#)).

In the preservation or restoration of films, there are three main concepts ([Hargadon & Sutton, 1997](#)):

1. Collection (acquisition). The acquisition is the initial activity that determines the movie which will be saved. The government or related institutions should be able to ensure that any films created must have a certain archive. The collection also illustrates the level of creativity of the artists in terms of quantity. Acquisitions may involve educational institutions, production houses, arts workers, and libraries.
2. Processing. In this context, the processing is related to maintenance in order that the film remains as intact as the original. Film material tends to be fragile; it requires proper film processing policy, especially concerning storage facilities so that they are not damaged quickly. Processing also relates to access to the wider community. The development of technology today is very possible to perform processing easily. Digital storage technology (Storage) allows us to process the collection of films and make parts of library materials. Processing may involve Indonesian national libraries or other libraries.
3. Access. In this case how people can access movies easily. So far government and artists have focused only on the production of a film and its storage, but do not think about access issues. Movies must have an "exclusive" period. For example, one year after its circulation, a film should belong to the public, easily accessible. This access is very important in fact something that is physically present. Movies can only be graded if the public knows the contents of the film and for that access should be made easier.

Digital Restoration

Digital film restoration is the same as the sequence of scanning images to digital form, the process of transferring a film image to digital video signals. Manipulate images to recover damage using the software at workstations. Rendering digital images, re-recording video data back to film. Film image → Film scanner → Digital image store → Workstation → Digital image store → Movie recorder → Film ([Read & Meyer, 2000](#)).

[Enticknap \(2013\)](#) states that chemical photo duplication is a copying act that preserves visuals from film sources, can be manipulated in various levels and accuracy depending on the condition of the film, technological progress, operator skills, and budget funds. Digital workflows basically capture digital representations of image sources, manipulate using

the software. When the work has reached the restorer satisfaction point, then the output will come out in various formats according to the desired access.

Digital Restoration Steps

In carrying out the restoration process there are several stages that must be passed. [Enticknap \(2013\)](#) in his book explains the stages as follows:

1. Technical Selection

Before the restoration method is determined using chemical photo techniques or using digital duplication, the performer of the restoration must identify which elements or parts will be restored. Each duplicate using photochemical technique, it will change the photographic aesthetic of the image itself. Some even experience a decrease in quality. But keep in mind, film viewers never saw the original film before the restoration, so they will not be too aware of the difference.

2. Physical Repair of Film Elements

After completion of the identification of the parts that require physical repair. Then the selection of techniques for improvement is carried out. Every person involved in carrying out a restoration must have his own interpretation of what technique is best to use. Sometimes this can lead to conflict between one another. As much as possible physical repairs must be effective, in the sense of having the smallest risk, the lowest cost, and the work. But the most preferred is to minimize risk.

3. Film Cleaning

In 1979 film cleaning techniques emerged using ultrasonic devices. The ultrasonic technique is realized that it is an ideal technique for archiving both practically and ethically. Practically ideal because cleaning is done using mechanical devices, thus minimizing film contact with humans. But the biggest disadvantage of this technique is that the carbon tetrachloride liquid used to clean the film can be fatal to humans who are exposed to the liquid. The substances contained in this liquid can cause serious diseases such as attacking the nervous system, damaging the liver and kidneys, and can damage the ozone layer and greenhouse gases.

4. Scratch Reduction

Various ways have been done to remove scratches on the film element. If the level of scratches is light, the film can be fixed with a technique called rewashing. This process the out by washing chemical residues from the film emulsion. The procedure starts when the film is placed through a rotating glass-shaped wheel while immersed in acetone.

5. Master Element Assembly

After all, stages have been completed, they will be printed positively. Of the positives, it will be printed one or more negatives. In some cases of restoration, the film footage is even taken from various years depending on which part is best so that the resulting restoration is also maximal. Not to forget also, the person who carried out the restoration made a note during the restoration in terms of making decisions that occur during the process. For example, what improvements must be made and why the method of improvement was chosen. So other people who want to see films that have been restored can understand fully.

METHOD

This research uses the qualitative approach with the case study method. [Creswell & Miller \(1997\)](#) defines case studies as an exploration of bounded systems or cases, an interesting case to examine because of the typical feature of the case that has meaning for others ([Briandana, Doktoralina, & Sukmajati, 2018](#)). According to [Bogdan & Taylor \(1990\)](#), the case study is the in-detail testing to one background or subject or place of documents or event. [Jankowski & Jensen \(2002\)](#) restricts the case study approach as an approach with the attention of one case intensively and in detail. Moreover, [Dwityas & Briandana \(2017\)](#) gives technical limitation with the focus on the characteristics. [Yin \(2006\)](#) explains that in the case study the researchers should test units or individuals in depth.

Primary data in the research comes from an interview with six informants. The informant is part of a film company that is a pioneer in film restoration activities in Indonesia. The informants are then selected based on a purposive sampling technique. The criteria for selecting informants refer to the role of each informant in the film restoration process carried out. Each of the informants is a practitioner who is engaged in film restoration, from the production manager, head of the restoration, head of the film laboratory, film scanning, and film editor. The justification for choosing an interview relates to the role of informants. They are considered important in the research because they can give information, they can offer suggestions on other sources of evidence supporting the existing data.

RESULTS AND DISCUSSION

Based on the results of the research, there are several processes in film restoration. The first is the preservation process.

This is a process of taking care of a film tape so that the condition of the celluloid film band can be maintained. Preservation itself is a step that always accompanies the restoration process. How to distinguish what preservation and restoration lie in how the process works. Preservation is a process whereby material of celluloid film tape is cleaned and removed from its container and cleaned by using certain liquids and checking from any damage to the celluloid film band from frame to frame.

Meanwhile, restoration is a digital scan and cleaning process. The process of restoration itself depends on how long the duration of collecting from the existing film materials then the process of digital restoration can be done. The process of scanning and cleaning digitally on the film tape also takes a long time depending on the extent of damage from any existing film material.



Figure 1 & 2: Results of restoration film

Source: Author

In summary, we should be able to keep each film tape well to avoid fatal damage. Because the process of restoration of a celluloid film tape has to go through long steps before doing the scanning process on the celluloid film tape. To maintain the condition of celluloid film tape must go through a manual process called preservation of the film first. Especially in the process of preservation, we measure a long step to find out how good the material of the existing celluloid tapes, whether the film tape can be saved or even reusable.

Restoration Process

In the film restoration process, the damage of film celluloid tape has to be known at first. After knowing the damage in the celluloid tape material, some decisions have to be taken on the celluloid tape whether it can be used again or not before it enters into the film tape scanning. If the film tape cannot be used again, we can look for other tape materials, such as Betacam, mini DV, VCD, DVD or other media frequently used such as YouTube. However, if the materials can be not found, the shoot will not be used. The measure should be carried out because it will save each archive and shoot. Therefore, it can be saved totally. After that, it will enter into the scanning of film celluloid material. The scanning process has a purpose to save the broken film tape. It will protect it from worse damage in the film celluloid tapes. Therefore, the measure should be carried out.

Preservation Process

The treatment of the film tape is known as the "preservation" process. It is a treatment process when the condition of celluloid film tape can be protected. It is always carried out together with the restoration process. How to make difference between the preservation and the restoration is located on how the process will be conducted. The preservation is a process where a celluloid film tape material can be cleaned and taken out from the storage place. Moreover, the cleansing process is carried out with the use of some liquid materials and checked from the damage of celluloid film tape from one frame to another.

On the other hand, the restoration is through scanning and cleansing process digitally. It definitely depends on how long the aggregation of each film material needs. After the aggregation, it can be conducted the restoration, scanning, and cleansing digitally. The film tape treatment called the preservation process is carried out in a kind of opening the storage place of the film tape which is usually in a kind of circle form and made from tin cans or plastic material which is currently mostly used as in figure 3.

After we see the transformation problem from analog to digital format and how innovation can be carried out with the purpose of reaching the intended audience target, the researchers connect the phenomenon with the diffusion innovation theory. In this theory, an idea, practice or thing is considered new to an idea, and it is published through an instrument of communication in a kind of television, radio or electronic media such as internet ([Rogers, 2010](#)).



Figure 3: Scrolling Material of Film Celluloid Tape

Source: Author

Moreover, the theory having been stated by Roger has relevance and argumentation in the decision-making process for the innovation process. The theory describes the level of adopting innovation and phase of the decision making from an innovation (Lyytinen & Damsgaard, 2001). The subjects that influence the diffusion innovation include (1) The perceived attribute of innovation, (2) The type of innovation-decision, (3) The communication channels, (4) The nature of the social system, (5) The role of change agent. The researchers can give a description of the research of the restoration process as follows.

1. The Phase of Emerging Knowledge. In this matter, individuals or groups are directed to understand the existence and benefit of how an innovation function.
2. The Phase of Persuasion. In this matter, individuals (or units of another decision making) build whether their attitude is good or bad. In relation to the innovation itself, it is whether the innovation is beneficial or not. For example, current innovation is the film restoration on whether it can stimulate film connoisseurs to watch films broadcasted with the perfect picture quality of High definition (HD) for the paid television broadcasting services.
3. The Phase of Decision. It appears when individuals or units of other decision-making are involved in the activities that direct the choice of innovation adoption or refusal. The phase considers how the benefits and losses of new innovation can be applied or adopted. From the researcher's interview to the key informants, they consider that the restoration is able to give a place where we can watch the old films with high historical values again. It supports the aspect of profit for each film has been successful in the restoration process.
4. The Phase of Implementation. It occurs when individuals or units of other decision making stipulate the uses of an innovation. In this phase, it relates to individuals who have been involved in the job. From the results of the researcher's interview with the Key Informants, they will look for further the restoration through media as well as companies who send several of their employees to learn and participate in seminars on the restoration at abroad. Moreover, they will do exploration through nucoda application if they want to solve the problem when damage occurs.
5. The Phase of Confirmation. It occurs when individuals or units of other decision-making look for ways of supporting the decision of receiving or refusing the invasion made in the past.

Moreover, the research results indicate that film restoration has given some important things among others:

1. Better Picture Quality. Appropriate to the previous description with fast technology development, the presence of technology can provide a new description of the innovation particularly in the production of better pictures in the digitalization (restoration) to each old film work. Moreover, the films can be adapted to better quality in the present day. With the flexible quality in the digitalization process (restoration), each produced picture can be manipulated with the picture quality appropriate to the current situation such as High Definition pictures and the picture quality with the wider dimension or 4K resolutions.
2. Fewer Competitors. For fewer competitors in the sector, PT Tiga Belas Entertainment has succeeded to establish a television channel with the different entertainment broadcasting products through Flik TV. In the production, Flik TV mostly broadcasts old films with better picture results so that the public can accept the broadcasting services.
3. Becoming New Selling Values. According to the research's informants, the film restoration has a purpose of returning the economic value and history from analog to digital format so that it can return the selling products. It can be concluded that the digitalization process actually has economic values particularly for companies with the core business in the sector of social media. It is used to introduce each promotion of the existing programs. Therefore, it is profitable for each social media account.

From the discussion on Indonesian film restoration, many challenges must be faced and resolved according to the dynamic physical condition of the film. This is consistent with research conducted by the [Indriawanti \(2013\)](#); [Suryani \(2019\)](#) that the level and type of damage between films are almost nonexistent with each other. That requires knowledge and perseverance to work on film restoration. Restorer must be painstaking in the process of each process. Restoration stages are in accordance with [Enticknap \(2013\)](#). There is some damage found, but not mentioned in the book Enticknap (2013), i.e. flicker, and warping (corrugated film frame). The process of the stages of restoration work through the selection of the desired type of restoration, physical checking, repair and physical cleaning of the film, scanning, editing, and finishing ([Read & Meyer, 2000](#)).

CONCLUSION

1. The development of technology can have the most influential effect to save films with high commercial values. Moreover, it is expected to save the films with high historical values. Through the film digitalization, the restoration helps to change the unfeasible films to broadcast due to the damage with the production age, and therefore, these will be able to have quality with the current situation.
2. The digitalization is an innovation that has to be developed to save films and documentaries with high historical values so that each generation can learn and know the history of events that had occurred in the past.
3. Despite the fact that the digitalization process (restoration) has been stated too expensive, we should introduce the restoration through Indonesian television broadcasting industry. It will help an audience to learn history from the old films. Since in the old films or documentaries, the writer sees messages or values in the films, and these have good messages to be learned and applied in life particularly for students.
4. The presence of film restoration through the programs broadcasted on FlikTV can be seen that the old films have the selling values in the broadcasting activities and these will be able to meet the segmentation in the television broadcasting industry in Indonesia. As presented by the research's informants, the film tape is movable assets that have high economic values so that the restoration has the purpose of returning such economic values.
5. The technology development is able to stimulate each person to increase knowledge in the sector of restoration. Moreover, the restoration has emerged a new skill in digital restoration.

LIMITATION AND STUDY FORWARD

This research is limited to one case that occurred in Indonesia. Due to the lack of film restoration activities in Indonesia, the results of this study can be beneficial for film activists and stakeholders. However, because film restoration activities are closely related to technological developments, further research is needed on film restoration cases that are in accordance with future technological developments.

IMPLICATION

Due to the lack of film restoration activities in Indonesia, the results of this study can be beneficial for film activists and stakeholders. However, because film restoration activities are closely related to technological developments, further research is needed on film restoration cases that are in accordance with future technological developments. This research will contribute to the knowledge of the concept of film restoration in Indonesia and technology.

ACKNOWLEDGMENT

We would like to show our gratitude to the Research Centre at Universitas Mercu Buana, to the Universitas Padjajaran Bandung, to the Mr. Caturida Meiwanto Dokotralina, and to the independent reviewers who conducted a feasibility study of our research work

REFERENCE

1. Amir, S. (2012). *The technological state in Indonesia: The co-constitution of high technology and authoritarian politics*. Routledge. <https://doi.org/10.4324/9780203084120>
2. Barker, T. A. C. (2011). *A cultural economy of the contemporary Indonesian film industry*. ScholarBank@NUS Repository.
3. Bogdan, R., & Taylor, S. J. (1990). Looking at the bright side: A positive approach to qualitative policy and evaluation research. *Qualitative Sociology*, 13(2), 183–192. <https://doi.org/10.1007/BF00989686>
4. Briandana, R., Dokotralina, C. M., & Sukmajati, D. (2018). Promotion Analysis of Marine Tourism in Indonesia : A Case Study. *European Research Studies Journal*, 7(7), 602–613. <https://doi.org/10.35808/ersj/973>
5. Briandana, R., & Dwityas, N. A. (2018). Comedy Films as Social Representation in the Society : An Analysis of Indonesian Comedy Films. *International Journal of Humanities and Social Science Studies (IJHSSS)*, 6959(107), 107–118.
6. Cave, D. (2008). “Born Digital”—Raised an Orphan?: Acquiring Digital Media through an Analog Paradigm. *The Moving Image*, 8(1), 1–13. <https://doi.org/10.1353/mov.0.0002>
7. Creswell, J. W., & Miller, G. A. (1997). Research methodologies and the doctoral process. *New Directions for Higher Education*, 1997(99), 33–46. <https://doi.org/10.1002/he.9903>

8. Dixon, D. P., & Zonn, L. E. (2004). Film Networks and the Place (s) of Technology. In *Geography and technology* (pp. 243–266). Springer. https://doi.org/10.1007/978-1-4020-2353-8_11
9. Dwityas, N. A. (2016). Komunikasi dan Pariwisata: Peran User Generated Content bagi Traveler dalam Media Sosial. *JURNAL SIMBOLIKA: Research and Learning in Communication Study*, 2(1).
10. Dwityas, N. A., & Briandana, R. (2017). Social media in the travel decision-making process. *International Journal of Humanities and Social Sciences*, 7(7), 291–292.
11. Enticknap, L. (2013). *Film restoration: The culture and science of audiovisual heritage*. Leeds: Springer. <https://doi.org/10.1057/9781137328724>
12. Flueckiger, B. (2012). Material properties of the historical film in the digital age. *NECSUS. European Journal of Media Studies*, 1(2), 135–153. <https://doi.org/10.5117/NECSUS2012.2.FLUE>
13. Hargadon, A., & Sutton, R. I. (1997). Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, 716–749. <https://doi.org/10.2307/2393655>
14. Indriawanti, D. P. (2013). *Restorasi Arsip Audiovisual di Arsip Nasional Republik Indonesia (ANRI)*. Universitas Gadjah Mada.
15. Jankowski, N. W., & Jensen, K. B. (2002). *A handbook of qualitative methodologies for mass communication research*. London: Routledge. <https://doi.org/10.4324/9780203409800>
16. Larry, J., Rosenberg, R., & Uhler, R. (1980). Thick-film technology: an introduction to the materials. *IEEE Transactions on Components, Hybrids, and Manufacturing Technology*, 3(2), 211–225. <https://doi.org/10.1109/TCHMT.1980.1135609>
17. Lyytinen, K., & Damsgaard, J. (2001). What's wrong with the diffusion of innovation theory? *Working Conference on Diffusing Software Product and Process Innovations*, 173–190. Springer. https://doi.org/10.1007/978-0-387-35404-0_11
18. Mattock, L. K. (2010). From film restoration to digital emulation: The archival code of ethics in the age of digital reproduction. *Journal of Information Ethics*, 19(1), 74. <https://doi.org/10.3172/JIE.19.1.74>
19. Morissan, M. (2016). The Influence of Politicians on Television Content in Post-Authoritarian Indonesia. *JSP (Jurnal Ilmu Sosial Dan Ilmu Politik)*, 20(3), 204–220. <https://doi.org/10.22146/jsp.27205>
20. O'Connell, P. J. (2010). *Robert Drew and the development of cinema verite in America*. SIU Press.
21. Read, P., & Meyer, M.-P. (2000). *Restoration of motion picture film* (P. Read & M.-P. Meyer, Eds.). Oxford: Elsevier.
22. Rogers, E. M. (2010). *Diffusion of innovations*. Simon and Schuster.
23. Setijadi-Dunn, C., & Barker, T. (2010). Imagining “Indonesia”: Ethnic Chinese film producers in pre-independence cinema. *Asian Cinema*, 21(2), 25–47. https://doi.org/10.1386/ac.21.2.25_1
24. Soesastro, H. (1998). Emerging patterns of technology flows in the Asia-Pacific region: The relevance to Indonesia. *Hill & Thee (Editors)*, 1998, 303–325.
25. Suryani, J. (2019). *Restorasi Film Indonesia Studi Kasus Film Bintang Ketjil (1963)*. Universitas Multimedia Nusantara.
26. Wallmüller, J. (2007). Criteria for the use of digital technology in moving image restoration. *The Moving Image*, 7(1), 78–91. <https://doi.org/10.1353/mov.2007.0032>
27. Yin, R. K. (2006). Case study methods. In *Handbook of complementary methods in education research* (Vol. 3). London: Routledge.