An Examination of the Documentary Film "Einstein and Eddington" in terms of Nature of Science Themes, Philosophical Movements, and Concepts

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Abstract
This study aims to examine nature of science themes, philosophical movements, and overall concepts covered in the documentary film, "Einstein and Eddington". A qualitative research method was used. In this study, the documentary film "Einstein and Eddington," the viewing time of which is 1 hour and 28 minutes, was used as the data source. Content analysis was used to analyze the data. As a result of the research, it has been found that the documentary put emphasis on the philosophical movements of positivism, rationalism, and relativism. It has been identified that five nature of science themes have been addressed in the documentary, namely that scientific knowledge is tentative; that it includes logical, mathematical, and empirical inferences; that it is subjective; that it is partly the product of human imagination and creativity; and that it is influenced by social and cultural factors. The documentary included concepts related to Einstein's Theories (General and Special Relativity), light deflection in the gravitational field and solar eclipse. As a result, this study showed that "Einstein and Eddington" is a documentary film that could be used in the instruction of some nature of science themes, philosophical movements, and concepts.

Keywords: Einstein and Eddington, nature of science, philosophical movements, teaching concepts, content analysis

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Introduction

In the historical process, as the fundamental understandings in reaching knowledge change, the beliefs about the nature of knowledge also change. These changes also raise new conceptions in the processes of conveying knowledge to new generations. One of the most widely accepted conceptions is that learning is highly subjective; everyone has a different learning capacity, and each individual can learn a particular knowledge if suitable methods are used. This puts the "learning" phenomena and the learning-teaching processes at the center of attention (Özden, 2013). As a product of this effort focused on the learning, various teaching methods and techniques were developed towards an effective learning and teaching process. For effective instruction, teachers are required to select the most appropriate methods and techniques regarding themselves, their students, the subject area, and the behaviors that they want to raise (Fidan & Erden, 1994).

In the education-teaching process to which the contemporary approach was adopted, the teacher helps students to improve their skills regardless of the subject matter. The goal of this kind of instruction is not to memorize knowledge; it is intended to ensure the use of knowledge in order to acquire new knowledge from it, or in other words, to ensure thinking (Özden, 2014). The goal here is not to transfer the existing knowledge to students; it is to teach them the ways of accessing the knowledge.

Science-related issues usually contain abstract and complex concepts, which cause them to be perceived as difficult to understand. Therefore, to help students learn in science courses at the required level, concrete and visual materials should be used together with effective teaching methods and techniques, even in the teaching of abstract concepts (Gezer, Köse, & Sürücü, 1998). Thus, teachers will be able to train science literate individuals instead of students who fear the course or have difficulty understanding it.

Science literate individuals are quite important for communities, as they can solve the social and environmental problems of 21st century (Eisenhart, Finkel, & Marion, 1996). Scientific literacy means individuals can participate in an informed decision-making process featuring issues of daily life (DeBoer, 1991) and evaluate science as a part of modern culture (Hanuscin, 2013). In this context, to reach the scientific literacy goal, understanding the nature of science (NOS) has become a prominent target in science education reform (AAAS, 1993; MEB, 2013; NRC, 1996).

For science literacy education, it is necessary to teach not only science concepts and theories, but also the nature of these concepts and seeing how they function together with the physical world (Eichinger, Abell, & Dagher, 1997). Understanding of science in recent years has moved away from the traditional positivist view, which used to define science dependent to authority and independent of objective and cultural influences. The nature of science is defined within a frame based on the relative structure of science and the studies of philosophers such as Kuhn and Hanson. According to the post-modern approach, science is theory- and culture-dependent and subject to human initiative, which is based on experimental observations (Schwartz, 2004). Science is an engagement in trying to find the truth and to explain the factual world (Sönmez, 2008). Science is the product of humanity's common thought. Understanding science provides practical information to people in everyday life.

McComas, Clough, and Almazroa (1998) defined the nature of science as a mixture of various aspects of social sciences, such as science philosophy, science history, and science sociology, integrated with mental sciences, such as psychology in investigating the explanations of issues such as how science works, how scientists work as a social group, how the community drives scientific efforts, and how it reacts. According to Lederman (1992), the nature of science is seen as the values and beliefs inherent in scientific knowledge.

Although there is no single and universally accepted definition of NOS at present, an important academic consensus has been achieved about the aspects of NOS that should be taught in school science (Lederman, Abd-El-Khalick, Bell, & Schwartz, 2002; Smith, Lederman, Bell, McComas, & Clough, 1997; Smith & Scharman, 1999). These aspects are: scientific knowledge, which includes “facts,” “theories,” and “laws” is both reliable and tentative, empirically based, subjective and/or theory-laden, partly the product of human imagination and creativity, subject to a distinction between observations and inferences, and influenced by social and cultural factors; and theories and laws are different types of knowledge (Lederman, 2007).Scientific knowledge is subject to change in an evolutionary or revolutionary way, with the acquisition of new data or re-interpretation of existing data (Lederman et al., 2002).

Science is a concept associated with philosophy as well. Science attempts to reach the truth using scientific methods. It provides highly accurate, proven information obtained via experiment, observation, review, and research. On the other hand, philosophy attempts to reach the truth via the information obtained from the science, as well as other areas, such as art, thought, and ethics (Sönmez, 2009). Scientists have adopted different philosophical movements to obtain accurate information or to distinguish science from other ways of thinking. Scientific Outlook, Empiricism, Positivism, Rationalism, and Relativism are among these movements. Scientific Outlook argues that there is no subject or fact that science could not handle. Those who adopted this view represent an extreme, suggesting that scientific method can even address philosophy, art, and morality (Topdemir, 2011). The knowledge obtained through science allowed humanity to control the natural environment and provided the ability to use the offerings of nature to facilitate life, to live more comfortably, more securely, and longer (Doğan, Çakıroğlu, Bilican, & Çavuş, 2009). The major representative of the Empiricism movement is John Locke (1632-1704). According to Locke, at the beginning the human mind is a blank sheet without any mark on it (tabula rasa). From here, it can be concluded that John Locke accepted observation and experiment as the only sources of knowledge (Topdemir, 2011). Positivism, which emerged in the 18th century, represented by Auguste Comte (1789-1857) and Ernst Mach (1838-1916), has adopted a more advanced status than Kant about science’s area of knowledge and the possibility of metaphysics (Topdemir, 2011). Kant acknowledged that metaphysics had a moral value in the practice, Comte and Mach claimed that metaphysics had no value. According to Sönmez, Kantian ethics is a philosophic system pretending that accurate information can be obtained from the review of facts and this kind of information can only be provided by experimental sciences. Positivism suggests that we can understand the outside world via the information obtained from observation and experiment. Rationalism is a philosophy suggesting reason as the chief source and test of knowledge. Socrates, Plato, Aristotle, and Descartes are a few of the philosophers who adopted rationalism. The scientist who suggested relativity is Einstein. According to Einstein's theory of relativity, time is associated with the speed of light; space is also related to it (Sönmez, 2008). Feyerabend has also adopted relativity. He pretended that the meanings of the terms used in a scientific explanation may change over time with the emergence of new explanations (Feyerabend, 1995).

Using the history of science in teaching scientific concepts provides in-depth thinking and discussion opportunities to students (Matthews 1994). Explaining the history and stages of scientific knowledge during science courses, as opposed to only instructing on scientific issues and major scientific laws, will help students to understand the nature, history, and philosophy of science (Türkmen & Yalçın, 2001). In the history of science, it has been seen that many scientists have carried scientific knowledge into daily life. Galileo’s (1564-1642) use of the telescope for astronomical purposes, the Wright brothers’ (Orvil, 1871-1948; Wilbur, 1867-1912) flying away from land with the first plane called Flyer I, Alexander Graham Bell’s (1847-1922) invention of telephone, and Thomas Alva Edison’s (1847-1931) discovery of electric light bulb are all examples of scientific knowledge finding application in daily life (Seçkin Kapucu, 2013).

In order to ensure students’ upbringing as science literate individuals, it would be useful to instruct science courses with the aid of systematically prepared and planned documentary films, which are based on the life of scientists, to teach them the phases of science, characteristics of scientific knowledge, how scientific knowledge has changed over time, and the ways of reaching scientific knowledge. In this way, students will find the opportunity to learn about science, the nature of science, the features of scientific knowledge, and scientists. In addition, students' bias on this issue may disappear, so they may be more interested in science.

This study attempts to show how themes on the nature of science and philosophical movements and concepts take place in the documentaries. Here, this is done specifically by examining the documentary film "Einstein and Eddington." For this purpose, the following questions were addressed.

- Which nature of science themes were covered in documentary film "Einstein and Eddington"?
- Which philosophical movements were covered in documentary film "Einstein and Eddington"?
- Which concepts were covered in documentary film "Einstein and Eddington"?

Methodology

Design of the Study

A qualitative method was used in this study aiming to examine nature of science themes, philosophical movements, and overall concepts taking place in the documentary film "Einstein and Eddington."

Data Source

In addition to written sources, visual materials such as film, video, and photograph can be used in qualitative research (Yıldırım & Şimşek, 2011). This film (Martin, 2008) was selected as the data source for the content analysis. The film contains many topics, such as characteristics of scientists, lives of scientists, studies of scientists, scientific research process, the experiences of the scientists in this process, how science affects society, how society affects science, and cooperation between scientists. Therefore, the present researchers attempted to investigate the film in terms of the nature of science, philosophical movements, and concepts. The documentary film is about the development Albert Einstein's general theory of relativity and Sir Arthur Eddington, a British scientist who had proven his ideas experimentally. In the film, it has been proven that Newtonian physics has been unable to respond to new requests by Einstein and Eddington, and it was supposed to be eliminated. In the movie, many scientists were mentioned, namely Isaac Newton, Max Planck, Fritz Haber, and Wilhelm Rontgen. The film differentiates itself from other documentaries in terms of featuring the cooperative work of many scientists and attempting to prove Albert Einstein's theory experimentally. In the study, the British-made documentary film "Einstein and Eddington," the view time of which is 88 minutes, was used as a data source.

Data Analyses

A qualitative data analysis is a process in which the researchers organize the data, divide it into analysis units, synthesize it, reveal a pattern, explore important variables, and choose the information to reflect in the report (Bogdan & Biklen, 1992).

A content analysis technique was used for data analysis. Data analysis was based on various characteristics of scientific knowledge, which were agreed upon among many researchers (Lederman, Abd-El- Khalick, Bell, & Schwartz 2002; Smith, Lederman, Bell, McComas, & Clough, 1997; Smith & Scharman, 1999). These characteristics are: scientific knowledge is reliable but it is subject to change; scientific knowledge includes logical, mathematical, and empirical inferences; scientific knowledge is subjective; human imagination and creativity have an important role in the acquisition of scientific knowledge; scientific knowledge is influenced by social and cultural climate; observation and inference are different things; and scientific theories and laws are different types of information (Lederman, 2007). Although there is no single and universally accepted definition of NOS, at the moment, an important academic consensus has been achieved that the aspects of NOS should be taught in school science (Lederman, Abd-El-Khalick, Bell, & Schwartz 2002; Smith, Lederman, Bell, McComas & Clough, 1997; Smith & Scharman, 1999). These aspects are: scientific knowledge, which includes "facts," "theories," and "laws" is both reliable and tentative, empirically based, subjective and/or theory-laden, partly the product of human imagination and creativity, subject to a distinction between observations and inferences, and influenced by social and cultural factors; and theories and laws are different types of knowledge (Lederman, 2007). The categories associated with the characteristics of scientific information, which were required for the first question of the research, were set. These categories were considered during the analysis. Regarding the second and third questions of the research, philosophical movements (Scientific Outlook, Empiricism, Positivism, Rationalism, and Relativism) and concepts included in the literature were considered.

First, transcripts of the conversations in the film have been formed. The transcripts have been transferred into written form, yielding a total of 84 pages of written text. Then the documents were read and the information was coded. Afterwards, coded documents were combined and examined according to the purpose of the study. Each data point was first open-coded, and then coded data were grouped into categories based on the relationships among codes. At the second stage, all categories were described, summarized, and explained under themes (Miles & Huberman, 1994). For the sake of reliability, two researchers have coded the data separately, independently of each other. Then the codes were compared. No statistical analysis was performed while comparing the data; instead, an overall comparison was performed and a consensus was established by discussing a few codes. The coding compliance level was found to be high.

Findings

Nature of Science Themes Included in the Movie

The review of the film in terms of nature of science themes revealed that five nature of science themes were mentioned. These are: scientific knowledge is reliable but it is subject to change; scientific knowledge includes logical, mathematical, and empirical inferences; scientific knowledge is subjective; human imagination and creativity have an important role in the acquisition of scientific knowledge; and scientific knowledge is influenced by social and cultural factors at the developmental and practical stages. In this study, the researchers attempted to explain the nature of science themes included in the documentary film named "Einstein and Eddington" by giving examples of the film’s dialogue.

Scientific knowledge is reliable but is subject to change: Regarding the dialogue of the movie Einstein and Eddington, the statement “and we have a new theory of gravity” implies the malleability of scientific knowledge. The dialogue quoted from the film Einstein and Eddington and the corresponding appearance times are shown in Table 1.

Table 1. *Scientific knowledge is reliable but is subject to change*

Duration	Dialogue	Scientific knowledge	Explanation
01:22:17,040--> 01:22:21,238	then the sun's gravitational field has shifted the stars' position	Scientific knowledge is reliable but is subject to change.	Scientific knowledge is subject to change with new observations and re-interpretation of existing observations (Doğan at al., 2009).
01:22:21,280 --> 01:22:24,033	and we have a new theory of gravity.		

Scientific knowledge includes logical, mathematical, or experimental inferences: Among the dialogue of the movie, the statement “then the sun's gravitational field has shifted the stars' position” mentions scientific knowledge including logical, mathematical, or experimental inferences. The dialogue quoted from the film “Einstein and Eddington” and the corresponding appearance times are shown in Table 2.

Table 2. *Scientific knowledge includes logical, mathematical, or experimental inferences*

Duration	Dialogue	Scientific knowledge	Explanation
00:17:03,120--> 00:17:07,830	What use is science if it has no practical application?	Scientific knowledge includes logical, mathematical, or experimental inferences.	Scientific knowledge is based on the data obtained from the observation of nature and experiments (Doğan at al., 2009).
01:09:39,040--> 01:09:42,316	As we look at the eclipsed sun through the giant telescope,		
01:09:45,640--> 01:09:50,111	We'll take photographs of these stars during the five minutes of eclipse,		
01:09:50,160--> 01:09:52,913	and then compare them to photographs taken of the same stars at night.		

Scientific knowledge is subjective: Regarding the dialogue of the movie, the statement "Einstein says that time is not the same for all of us..." is about the subjectivity of scientific knowledge. The dialogue quoted from the film Einstein and Eddington and the corresponding appearance times are shown in Table 3.

Table 3. *Scientific knowledge is subjective*

Duration	Dialogue	Scientific knowledge	Explanation
01:23:34,880--> 01:23:40,352	Einstein says that time is not the same for all of us...	Scientific knowledge is subjective.	According to Newton, a bar of one meter long is one meter in all parts of the universe. However, according to Einstein, a bar of one meter long becomes shorter as it moves faster (Sönmez, 2008).

Human imagination and creativity have an important role in the acquisition of scientific knowledge: Regarding the dialogue of the movie, the statement "Pick up the tablecloth. Space. The tablecloth is space," implies that imagination and creativity are important in the acquisition of scientific knowledge. The dialogue quoted from the film "Einstein and Eddington" and the corresponding appearance times are shown in Table 4.

Table 4. *Human imagination and creativity have an important role on the acquisition of scientific knowledge.*

Duration	Dialogue	Scientific knowledge	Explanation
01:07:37,160--> 01:07:39,276	Pick up the tablecloth.	Human imagination and creativity have an important role in the acquisition of scientific knowledge.	Since science is a human product, imagination and creativity are inevitable in the acquisition of scientific knowledge.
01:07:43,280--> 01:07:45,794	Space. The tablecloth is space.		

Scientific knowledge is influenced by social and cultural factors at the developmental stage: Regarding the dialogue of the movie, the statement "Would you see that this gets to Cambridge? They won't allow me to post it. But you... you are... They would allow you to. Please," shows that scientific knowledge is influenced by social and cultural factors at the developmental stage. The dialogue quoted from the film "Einstein and Eddington" and the corresponding appearance times are shown in Table 5.

Table 5. *Scientific knowledge is influenced by social and cultural factors at the developmental stage.*

Duration	Dialogues	Scientific knowledge	Explanation
01:06:19,600--> 01:06:21,079	Pass, please.	Scientific knowledge is influenced by social and cultural factors at the developmental stage.	Scientific knowledge is mostly influenced by social and cultural factors such as economy, politics, religion, and philosophy.
01:06:24,840--> 01:06:28,913	Would you see that this gets to Cambridge?		
01:06:28,960--> 01:06:31,030	They won't allow me to post it.		
01:06:33,520--> 01:06:35,954	But you... you are...		
01:06:36,000--> 01:06:39,470	They would allow you to. Please.		

Philosophical Movements Included in the Movie

It has been found that positivism, relativism, and rationalism were the main philosophical movements referenced in the move. Below, the researchers attempt to explain the philosophical movements included in the documentary film "Einstein and Eddington" by giving examples from the film's dialogue.

Positivism: Positivism pretends that we can understand the outer world via the information obtained from observation and experiment. Dialogue about the solar eclipse is given below in Table 6. The dialogue is about an observation related to the eclipse. Thus, based on the dialogue, the existence of the positivism philosophy can be suggested.

Table 6. *Positivism*

Duration	Dialogues	Scientific knowledge	Philosophical movement
01:09:20,160--> 01:09:22,674	I know, too bright. But May 29th, 1919.	Scientific knowledge includes logical, mathematical, or experimental inferences.	Positivism
01:09:23,840--> 01:09:26,149	Total solar eclipse. A chance to look at the sun.		
01:09:26,200--> 01:09:27,679	- Where? - Africa.		
01:09:39,040--> 01:09:42,316	As we look at the eclipsed sun through the giant telescope,		
01:09:42,360--> 01:09:45,591	it will be directly in the middle of the Hyades star cluster.		
01:09:45,640--> 01:09:50,111	We'll take photographs of these stars during the five minutes of eclipse,		
01:09:50,160--> 01:09:52,913	and then compare them to photographs taken of the same stars at night.		
01:09:52,960--> 01:09:55,474	One photographic plate on top of another.		
01:09:55,520--> 01:09:58,592	Are the stars in the same place or different?		

Relativism: **“**Einstein says that the time is not the same for all of us , …
… and it is different for all of us. In such a relative point of view ….”

Einstein is the scientist who suggested relativity. According to Einstein's theory of relativity, time is associated with the speed of light; space is also related to it. From the dialogue displayed in Table 7, it can be concluded that relativity philosophy was included within the documentary.

Table 7. *Relativism*

Duration	Dialogues	Scientific knowledge	Philosophical movement
00:29:19,760--> 00:29:25,835	He's suggesting that time is at different speeds in the universe,	Scientific knowledge is subjective.	Relativism
00:29:25,880--> 00:29:28,872	depending on how fast you're moving.		
00:29:28,920--> 00:29:33,550	The faster you move, the more time... slows down.		
00:29:33,600--> 00:29:37,036	Time isn't the same everywhere?		
00:29:37,080--> 00:29:38,513	That's what he says.		
00:29:38,560--> 00:29:41,120	Yes, time isn't shared. It's not an absolute.		

Rationalism: It is the philosophical movement regarding reason as the chief source of knowledge. Scientists are mostly involved with events that cannot be directly observed, thus they tend to support their arguments with evidence that they have obtained implicitly (İrez & Turgut, 2008). From the dialogue displayed in Table 8, it can be seen that logical reasoning is important in science. Rationalism philosophy is effective in logical reasoning.

Table 8. *Rationalism*

Duration	Dialogues	Scientific knowledge	Philosophical movement
01:08:31,360--> 01:08:35,911	When starlight comes near to the sun, what will happen to it?	Scientific knowledge includes logical, mathematical, or experimental inferences.	Rationalism
01:08:35,960--> 01:08:38,076	It'll bend.		
01:08:38,120--> 01:08:40,315	Yes.		
01:08:43,720--> 01:08:47,952	Starlight will bend.		

Concepts Included in the Movie

In addition to philosophical movements and scientific knowledge, concepts were also reviewed using the documentary film “Einstein and Eddington.” The documentary included the concepts related to Einstein's Theories (General and Special Relativity), Light Deflection in the Gravitational Field and Solar Eclipse.

The theory of general relativity: The three main statements of general relativity (1916), which gives the gravitational theory of a four-dimensional universe, which is assumed to be curvilinear and finite, are as follows: space and time are not solid. Their shape and structures are affected by mass and energy. The deflection of space and space-time is determined by mass and energy, whereas the space and its deflection determine the movement of the bodies (Priwer & Philips, 2009). In terms of general relativity, it can be said that space-time is curved around the high-mass bodies. Table 9 shows the dialogue about the Theory of General Relativity.

Table 9. *The theory of general relativity*

Duration	Dialogue	Scientific knowledge	Explanation
01:07:16,440--> 1:07:19,557	It's called general relativity.	Scientific knowledge includes logical, mathematical, or experimental inferences.	Positivism
01:07:19,600--> 1:07:23,752	It's a theory of gravity and... everything. Excuse me. Let me explain it to you.		
01:07:27,240--> 1:07:31,028	Let me just... Sorry. Let me just show you.		
01:07:57,440--> 01:07:59,237	The sun makes a shape around it in space.		
01:08:25,120--> 01:08:29,193	Space tells objects how to move, objects tell space what shape to be.		

The theory of special relativity: The two special relativity assumptions of Einstein are as follows: First, the laws of physics are the same for all observers in uniform motion relative to one another. Second, the speed of light (c) is the same for all observers, regardless of their relative motion or of the motion of the light source (Priwer & Philips, 2009). Dialogue about the theory of special relativity are shown in Table 7, where philosophical movements were reviewed.

The deflection of light in a gravitational field: The light of a star is deflected while passing close to the sun due to the deformation of space by the sun. Therefore, observers on earth perceive this as the star moving away from the sun (Barnett, 1980). Dialogue about the deflection of light in the gravitational field are shown in Table 8, where philosophical movements were reviewed.

Eclipse: The brave prediction of Einstein, featuring the deflection of light in a gravitational field**,** was proven in a very impressive manner by the observations made during the full eclipse that occurred on May 29, 1919. Astronomers have very carefully measured the positions of the stars that are close to the Sun during the Eclipse (Priwer & Philips, 2009). Dialogue about the Eclipse are shown in Table 6, where philosophical movements were reviewed

Discussions and Conclusion

In this study, the documentary film "Einstein and Eddington," featuring the experiences of scientists, has been analyzed in terms of how it could be used to present the nature of science, philosophical movements, and overall concepts to the students. As a result of this analysis it has been found that five nature of science themes were touched. These are: scientific knowledge is reliable; scientific knowledge includes logical, mathematical, and empirical inferences; scientific knowledge is subjective; human imagination and creativity play an important role in acquiring scientific knowledge; scientific knowledge is influenced by social and cultural factors at the developmental and practical stages. It was seen that the film put emphasis on the philosophical movements of positivism, rationalism and relativism. The concepts included in the documentary are related to Einstein's theories: general and special relativity, light deflection in the gravitational field, and solar eclipse. As a result, it is suggested that the "Einstein and Eddington" documentary film could be used in the teaching of some nature of science themes, philosophical movements, and concepts.

Even though 2013 Science and Technology course curriculum consists of detailed activities and teaching methods featuring how to teach scientific concepts, there is no application about how to teach the nature of science or how to integrate it into the units (MEB, 2013). Therefore, this study attempted to perform an examination featuring how to use the visual materials in order to help spread the use of science history as an educational tool.

The use of such films, documentaries, videos, or similar materials in lessons is expected to accelerate the reasoning and learning process of students, to facilitate the making of discoveries concerning the nature of science, and to increase familiarity with scientific concepts. Therefore, students can learn a lot from this documentary in terms of the nature of science, philosophical movements, and overall concepts. In addition, it is suggested that the knowledge acquired through an event that has really occurred, compared to a method based on narration, will also be a better way for the assimilation and memorization of knowledge. Consequently, students who understand the stages and the history of scientific knowledge can more easily develop an understanding of the nature and the philosophy of science (Köseoğlu, Tümay, & Budak, 2008; Abd-El-Khalick, & Lederman 2000; Irwin, 2000; Klopfer & Cooley, 1963; Lin & Chen, 2002; Russell, 1981; Solomon, Duveen, Scot, & McCarthy, 1992; Şeker & Welsh, 2006; Türkmen & Yalçın, 2001; Yalaki & Çakmakcı, 2010).

Through activities performed with similar materials, students may be able to achieve learning via an enjoyable process in which they can participate actively. It is expected that students who meet and know the science, scientists, and scientific process through documentaries would be motivated to learn more, and therefore will wonder about the life stories of different scientists and develop awareness on this issue. Therefore, more visual materials, such as movies, documentaries, and animation should be analyzed, and their associations with the lessons, topics, or gains should be revealed. In addition, some criteria should be developed about the examination of the films. Films, differentiating in terms of various aspects of scientific knowledge, should be examined and compared.

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