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Research Article

The Impact of Science-Fiction Movies on the Self-Efficacy Perceptions of Their Science Literacy of Science Teacher Candidates

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Abstract

This study aims to determine the impact of science-fiction movies on science teacher candidates' self-efficacy perceptions of their scientific literacy. A mixed methodology was used in the study, which was conducted in the classes of Natural Sciences and Society with a total of 20 second-year teacher candidates from the department of primary education science teaching at a public university in Istanbul during the spring semester of the 2012-2013 academic year, over five weeks; 10 science-fiction movies were watched by these students in this period. Data were collected using a survey designed to capture self-efficacy perception of scientific and technological literacy that was composed of a 33-item instrument, with a 5-point Likert scale for responses to each item, and seven interview questions. The research data were assessed using the t-test for dependent samples, the descriptive statistics technique found in SPSS, and the descriptive analysis method, a qualitative method. The results show that science-fiction movies had a positive impact on the teacher candidates' self-efficacy perceptions of their scientific literacy. Furthermore, teacher candidates rated themselves "moderately capable" in 17 items in response to the survey instrument in the pre-implementation period, but this figure decreased to five following the implementation period.

Keywords

Science-fiction movie • Science teacher candidate • Scientific literacy • Self-efficacy perception • Self-efficacy perception of scientific literacy

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Scientific Literacy

Recent discoveries, technological breakthroughs, and the rapid pace of development in countries have led to a significant increase in the emphasis placed on scientific inquiry in particular and science in general. Different perspectives on traditional and modern scientific approaches have brought about innovations in various fields. Turkey follows this trend by describing science as a key criterion. This has increased the importance of both science and scientific knowledge, with many teaching programs at different levels focusing on the significance of scientific knowledge, distancing themselves from traditional educational approaches. Thus, the importance of science classes has been underlined. The vision of the Natural Sciences course was defined as “to educate all students as scientifically literate people, irrespective of their personal differences” (The Ministry of National Education General Directorate Board of Education, 2006, 2013). Çepni, Bacanak, and Küçük (2003) noted that the concept of natural science literacy, which was born at the end of the 1950s, was a main goal of education in the natural sciences, and that the natural science–technology–society movement gained significance.

The concept of natural science literacy entered discussions of education at the end of the 1950s, first introduced by (Hurd, 1958 as cited in Aslan, 2009; DeBoer, 2000; Laugksch, 2000; Turgut, 2005). In the literature, however, no common definition of this concept has been agreed upon (DeBoer, 2000; Laughksch, 2000; Turgut, 2005). According to the American Association for the Advancement of Science (AAAS, 1989), a science-literate person is “aware that science, mathematics, and technology are interdependent human enterprises with strengths and limitations; understands key concepts and principles of science; is familiar with the natural world and recognizes both its diversity and unity; and uses scientific knowledge and scientific ways of thinking for individual and social purposes” (AAAS, 1989 as cited in Cajas, 2001). The National Science Education Standards defines scientific literacy as having a certain level of science-related understanding to make sound personal choices, to engage in social and cultural debate, and to develop essential workplace skills (National Research Council, 1996).

Self-Efficacy Perception

Individuals’ accumulation of knowledge and competencies in various fields vary depending on various factors, such as social and personal characteristics. Kurbanoglu (2004) noted that the behaviors of human beings stem from their beliefs about their capacities rather than their competencies in achieving something, and connected this to humans’ self-efficacy perceptions. The concept of self-efficacy perception came to prominence after Bandura showed how beliefs are related to behaviors in his social cognitive theory in 1986. Bandura defines self-efficacy as “the belief in

one's capabilities to organize and execute the courses of action required to manage prospective situations" (Bandura, 1986).

Because individuals who have a strong belief in their capabilities tend to show a high level of endeavor and are willing to take on challenges even in risky conditions, the more a human being becomes aware of her/his self-efficacy and develops it, the more effectively and the more efficiently s/he works (Özgen & Bindak, 2008). While individuals who have high self-efficacy level are able to work in a more comfortable and efficient manner even while facing challenging situations, individuals with lower levels of self-efficacy believe what they will need to do is harder than it actually is (Yılmaz, Yılmaz, & Türk, 2010). In the development of self-efficacy perception, formal educational institutions and teachers are believed to be key, as well as the society itself. In this vein, teachers' efficiency and success in their teaching performances depend on their levels of self-efficacy perception. This shows it is necessary for teacher candidates to graduate from their universities as highly sophisticated individuals with high levels of self-efficacy perception. Cantrell, Young, and Moore (2003) and Öztürk (2008) concluded that it is of great importance to find ways to increase teachers' levels of self-efficacy and to put them into practice. Studies indicate that teachers with higher levels of self-efficacy perception of their teaching capabilities use many diverse teaching strategies in both pre-service and in-service practices (Koray, 2003; Rigs & Enochs, 1990). Graham, Harris, Fink, and MacArthur (2001) and Wertheim and Leyser (2002) suggest that teachers with higher self-efficacy perception levels tend to have a more student-centered approach, and this has a significant impact on their students' success and motivation levels (Martin, 2006). Various studies have shown that the precondition for effective learning relies on professional levels of self-efficacy perception. Studies of natural science teacher candidates in particular focus on the relation between the self-efficacy perception levels, academic success, and the impact of the differences in class levels and various variables on this level. A majority of existing studies focus on self-efficacy perception levels in a certain subject field, but few studies have focused on the self-efficacy perception levels and natural science literacy (Caymaz, 2008; Saracaloğlu, Yenice, & Özden, 2013). Although science literacy is a key concept and has received a special emphasis in the natural sciences curriculum thanks to educational reforms, students have quite low efficacy levels in this field (The Ministry of National Education, 2013). This shows that there are still problems in the educational and teaching process in spite of the ongoing modernization and that the issue must be approached from different perspectives. From this focus point, the study stresses on the self-efficacy perception levels in scientific literacy, which are thought to be a key factor in raising scientifically literate individuals. Caymaz (2008) defines scientific literacy as "people's perceptions about possessing the required scientific and technological skills, attitudes, values, understandings, and knowledge." Natural science classes

play an important role in the development of the self-efficacy perception of scientific literacy. Çoban and Sanalan (2002) find that natural science and technology classes have a significant impact on the development of self-efficacy perceptions.

Science-Fiction Movies

People's beliefs about whether they can achieve may affect their learning processes. This shows that specifically teachers and teacher candidates must have strong beliefs in enabling students to obtain science literacy. Individuals who can build a connection between science and daily life are able to understand her/his accumulation of knowledge more easily, differentiating her/his beliefs on succeeding in a significant manner. A key means for individuals on the road to making connections between science and the daily life is visual and printed media outlets.

As Seçkin Kapucu (2014) note, visual media affect people in all dimensions and have become an indispensable part of the educational system. Akbaş (2011) show that movies, a visual means of media, have become a part of daily life and have been used as a means of educational and scientific inquiry as well as a means of entertainment. Kirby (2003) state that movies are not just the accumulation of visual technologies, but also show social versions of scientific discussions by simply representing the natural world. One of the most important reasons why movies are effective in teaching is the familiarity of the visual media to younger generations (Alvarez, Miller, Levy, & Svejenova, 2004). Weber and Silk (2007) state that they prefer learning methods that attract students' attention and that movies are one of these methods. Dark (2005) notes that movies transpose the existing views to students in a rapid and easy manner, and he adds that these instruments are quite effective facilitators of "visual learning."

Movies in general and science-fiction movies in particular are visual tools that can be used in learning. While science-fiction movies are intended to offer entertainment to their audiences, they also develop their imagination, boost their interest in science and enable them to make forecasts in educational terms (Lundquist, 2012). Yazıcı and Altıparmak (2010) show that science-fiction movies, scripts, and narratives are effective teaching tools that can be used in science education. According to Ongel-Erdal, Sönmez, and Day (2004), educators have focused on using science-fiction stories as an educational tool in a bid to relate scientific concepts and field knowledge. The use of science-fiction materials attracts the attention of students more than other classroom activities and thus significantly increases the level of learning. Furthermore, such materials enable students to use their imagination, create opportunities to reflect and discuss and to learn the subject matter both theoretically and experimentally (Yazıcı & Altıparmak, 2010). Additionally, for many educational scientists, science-fiction activities are, by nature, inter-disciplinary, as they carry many themes from different disciplines, including the sciences, social relationships, fantasy, popular

art, religion, and so on (Aquino, 1976; Bixler, 2007). Science-fiction movies are attractive, as they have scientific content, include unreal science themes, narrate about the future, offer ideas about the development of technology, focus on the concepts of the good and the bad, address the imagination, and carry the effective power of the cinema, among other factors (Balbağ, Yenilmez, & Turgut, 2012). According to Cavannaugh and Cavannaugh (1996), science-fiction movies enable people to learn by making it possible for them to visualize scientific concepts and relate them with other disciplines. Barnett & Kafka (2007) showed that movies can enable people to create permanent images as long as they are verified by scientific knowledge. In his study using science-fiction films, Dubeck (1993) found that students understood the process of scientific inquiry and the science better and that such movies contributed to establish so-called scientific subject matter (cited in Ongel-Erdal et al., 2004). Many studies in the literature show how effective science-fiction-based teaching is, either through stories or movies.

Although there have been many science-fiction-based studies in other countries (Barnett & Kafka, 2007; Bixler, 2007; Kirby, 2003; Laprise & Winrich, 2010; Lin, Tsai, Chien, & Chang, 2013; Ontell, 1997; Powell, 2009; Rose, 2003; Segall, 2002; Shaw & Dybdahl, 2000; Yang, 2002), there have been very few in the domestic literature (Acar, 2003; Akbaş, 2011; Balbağ et al., 2012; Buluş Kırıkkaya, İşeri, & Vurkaya, 2009; Ongel-Erdal et al., 2004; Seçkin Kapucu, 2014; Yazıcı & Altıparmak, 2010).

Brake and Thornton (2003) establish an interaction between science-fiction films and society in their study. Czerneda (2006) also emphasize that science-fiction-based activities concentrate on how science works and that such activities constitute the foundations of scientific literacy. Science-fiction movies can be used as a teaching tool due to their entertaining nature and their reflection on the relations between science, technology, and society. This will enable students to learn concepts more easily and to attain awareness of what science really is. A student who can develop the relationship between science, technology, and society will make a connection between science and the daily life, understand scientific knowledge more easily and develop beliefs about achieving science classes in a positive manner. The results of this study will show what the contributions are of science-fiction movies that are a part of our daily lives to teaching are, as well as their impact on self-efficacy levels. Furthermore, the results will indicate the interactions created by students between daily life and science classes and the effect of examples from daily life. This study determines the impact of science-fiction films on science teacher candidates' self-efficacy perceptions regarding their scientific literacy. The research questions in line with this aim are as follows:

1. What level are the science teacher candidates' self-efficacy perceptions of their scientific literacy in the pre-implementation and the post-implementation periods?

2. Is there any significant difference between the levels of self-efficacy perception of the science teacher candidates of their scientific literacy in the pre-implementation and in the post-implementation period?

Method

The Research Model and the Research Group

A mixed methodology was used and variations were employed in the study. As Tashakkori and Creswell (2007) noted, mixed methodology studies are based on data collection, analyses, assessments, and suggestions, combining quantitative and qualitative methods and approaches into one study. The pattern of variation, a mixed model, is a research method in which qualitative and quantitative data are given equal importance so neither of these has any supremacy over the other (Tashakkori & Creswell, 2007 as cited in [Yıldırım & Şimşek, 2013](#)).

The study was conducted during the spring semester of the 2012-2013 academic year, and the research sample was composed of 20 second-year teacher candidates who were enrolled in the primary education science teaching department at an Istanbul-based university. Of these teacher candidates, who were between the ages of 18 and 23, 16 were females and the remaining four were males. The participants were chosen on a voluntary basis from among teacher candidates who took the course “the natural sciences and the society,” a two-credit elective course. Convenience sampling was used. In this method, the researcher accelerates the process by choosing easily accessible subjects who are familiar to the researcher ([Yıldırım & Şimşek, 2013](#)).

Implementation

The study was conducted in two stages: data collection and implementation. The implementation was completed during the two-credit course “The natural sciences and the society,” which was taught by the researcher in a theoretical manner for a 2-hour time span for each meeting. Science-fiction films, which were viewed throughout the research process, were chosen with consideration of the course content and the total teaching period in that semester, and the implementation was limited to five weeks. A total of 10 science-fiction movies, chosen by the researcher, were watched by the students. In choosing films, due consideration was given to whether various science concepts and fields, namely physics, chemistry, and biology, as well as the use of different technologies and the impact of these technologies in social life, were treated in the scripts. Additionally, movies showing the process of scientific inquiry were especially sought. The teacher candidates worked in two-person groups to ensure a greater interaction among them when the movies were reviewed. In forming two-person groups, class size and teaching period were considered. Thus, groups

were formed to make the movies viewable in the maximum numbers possible. After the groups were formed, the teacher candidates were asked to review the films in accordance with the criteria which were set by the researcher. In setting these criteria, a number of questions were prepared by the researcher, mainly in accordance with the aims of the study and the course, and then these questions were reorganized in line with the targets of the implementation course. The criteria were thus collected under six headings through which the basics of science, technologies, and society could be elaborated. The movies viewed and the assessment criteria are given in Table 1.

Table 1
The Movies Reviewed, Their Content and the Assessment Criteria

Film	Content/theme	Assessment criteria
<i>X-men</i>	Mutated people and their social impact	What is the main theme of the film? Which science concepts are involved in the movie?
<i>Lord of War</i>	The rise in armaments with technological advancements and its impact	Do these science concepts include accurate knowledge?
<i>Back to the Future II</i>	Various technological developments	Which technologies are referred to in the movie?
<i>The Day After Tomorrow</i>	The impact of humanity on nature	Is there a connection between science concepts and the technologies? If so, what?
<i>Clockstoppers</i>	Relativity theory	
<i>The 6th Day</i>	Genetic copying and related technologies	
<i>I, Robot</i>	Robots coming into humans' lives due to technology	Is there any impact of the science-technology fiction revealed in the movie on society? If so, can you explain what they it is?
<i>The Core</i>	Social impacts of a worldwide problem	
<i>Spider Man</i>	The unusual characteristics which can be attained by a genetically modified human	
<i>Armageddon</i>	Prevention of a meteorite by means of new technological designs	

The teacher candidates reviewed the movies using the above criteria and presented their responses verbally in groups. They briefly summarized the contents of the films by showing the movie trailers in their presentations. Afterwards, they examined the concepts of science in each film and elaborated whether these concepts were used accurately in the movie and whether there were any misconceptions. Additionally, they examined and presented all criteria set by the researcher one by one. These criteria for discussion were how the science–technology–society connection was built in the movie, what scientific inquiry was considered in the movie, whether any scientists took a role in it, and the whole process of scientific inquiry were examined in the classroom discussions. In these discussions, the researcher watched and listened to the teacher candidates' presentations. They were not asked to prepare any report. No video or audio recording was made.

Data Collection

The research data were collected through two means of data collection. In this section, these data collection instruments are elaborated.

The Self-Efficacy Perception Survey for Science and Technology Literacy

Teacher candidates' self-efficacy perceptions of their science and technology literacy were collected using a scale developed by Caymaz (2008). A draft survey composed of 54 items was developed by reviewing the related literature. The number of the items was decreased to 50 after the draft was evaluated through interviews with 10 teacher candidates, who were chosen randomly. The 50-item survey was assessed by a number of experts in terms of language, content and measurement validity, and then the number of items was reduced to 33. The pre-implementation of the scale was made in 344 second-year and third-year teacher candidates from the Primary Education Natural Science Teaching and Classroom Teaching Department. The scale's Cronbach's Alpha reliability coefficient was found to be .96. In the study, the scale's Cronbach's Alpha reliability coefficient was determined as .89. The questions are given in the Findings section. The survey was composed of 33 items with 5-point Likert-type scales for the response, with the following assignments made to the scores: (1) I am incapable, (2) I am slightly capable, (3) I am moderately capable, (4) I am quite capable, and (5) I am totally capable.

Interview Questions

To examine the scientific literacy of the teacher candidates in a detailed manner, interviews with them were conducted both in the pre-implementation and post-implementation periods. "Standardized open-ended interviews" were conducted with eight teacher candidates, who were chosen on a voluntary basis. These interviews took 15–30 minutes and were recorded to prevent any data loss.

The data obtained in the interviews were used to elaborate the results of the self-efficacy perception scale on scientific and technology literacy. For instance, an item for which the teacher candidates rated themselves as moderately capable was inquired about in the interview stage and the students were asked to explain in detail why they had marked that item in that way. Thus, the teacher candidates' views and thoughts were determined and some suggestions were given to enable them to develop their levels of self-efficacy perception.

The interview questions were prepared by the researcher, taking the survey questions into consideration. At this stage, the researcher endeavored to ask questions through which feedback could be obtained about the basics of the scientific literacy. Thus, a pool of questions was formed, and then the researcher selected a total of 15 questions out of this pool in line with the aims of the study. These questions were then redesigned after three experts in the field of natural science teaching had examined them relative to the research content, and finally seven interview questions were attained. The interview questions are given in the Findings section.

Research Data Analysis

Data on the teacher candidates' self-efficacy perceptions of their scientific literacy both in the pre-implementation and post-implementation periods were analyzed using the descriptive statistics technique. In determining levels of self-efficacy perception of scientific literacy, the following limits were held: 1.00–1.79 meant “I am incapable,” 1.80–2.59 meant “I am slightly capable,” 2.60–3.39 was “I am moderately capable,” 3.40–4.19 was taken as “I am quite capable,” and 4.20–5.00 was “I am totally capable.”

The change throughout the implementation process in the data on the teacher candidates' self-efficacy perceptions of their scientific literacy levels was analyzed using the program SPSS 17.0. The normalcy of the distribution of the existing data was determined by using a Kolmogorov–Smirnov test, as the sample group was smaller than 20. The results showed that the data were distributed normally, and a paired sample t-test was performed to measure whether the results changed between the pre-implementation and post-implementation period.

The data obtained from the interview questions were made into a written transcript and then the recordings were listened to again by the researcher to prevent any data loss. Afterwards, the existing recordings were heard by another researcher to minimize loss of data, if any. The results of the interview questions were assessed through the descriptive analysis method, a qualitative analysis technique. The data obtained through this method of analysis can be arranged according to themes from the interview questions, presented in consideration of the interview as a whole, or given according to observation questions or dimensions. To reflect the views of the subjects who were interviewed or made striking observations in the descriptive analysis method, direct quotations are frequently given. At this stage, data were selected and combined in a meaningful and reasonable manner in order to describe them. In line with the framework formed, some data can be excluded (Yıldırım & Şimşek, 2013, p. 256). From this focus point, the data obtained in the interview process were presented in the form of direct quotations after they were assessed in accordance with the results from the scale. Although direct quotations are given, the teacher candidates' identities are not disclosed; instead, a number is assigned to each to present quotations.

In assessing the interview results, which constituted the qualitative data of the study, all details about the role of the researcher, the characteristics of the participant subjects and the methods of data collection and data analysis were explained clearly to ensure reliability. Moreover, the results obtained from the interview questions are presented in a descriptive manner and were later confirmed by another researcher, who is an expert in this area. In order to ensure the validity of the data, all data were reported in a detailed manner and how the results were obtained was explained in detail.

Findings

The research findings are presented in a consecutive manner in accordance with the interview questions.

At What Levels are the Teacher Candidates' Self-Efficacy Perceptions of Their Scientific Literacy in the Pre-implementation and Post-implementation Periods?

Table 2 shows what levels the teacher candidates' self-efficacy perceptions of their scientific literacy are in the pre-implementation process and in the post-implementation process.

Table 2
*The Items In The Scale of the Self-Efficacy Perceptions About Scientific Literacy and the Average Score
 Stems in The Survey of the Self-Efficacy Perceptions About Scientific Literacy and Average Scores*

Items	Pre-imple- mentation period			Post-imple- mentation period		
	n	X	SS	n	X	SS
1. In differentiating scientific knowledge and unscientific knowledge (superstition) from each other	20	3.60	.82	20	4.20	.61
2. In searching for the source of a piece of knowledge	20	3.55	.60	20	4.05	.60
3. In questioning through what methods a knowledge is obtained	20	2.75	.71	20	3.85	.81
4. In assessing obtained knowledge in terms of scientific criteria (accuracy, reliability, integrity, neutrality, actuality, and so on)	20	3.10	.85	20	3.85	.93
5. In showing scientific attitudes and behaviors (curiosity, humility, skepticism, open mindedness, precision, tenacity, and so on)	20	3.30	.65	20	3.70	.57
6. In differentiating science from inaccurate superstition	20	3.70	.97	20	4.35	.58
7. In moving using scientific knowledge rather than feelings and superstitious beliefs	20	3.70	.92	20	4.00	.72
8. In examining existing knowledge in the light of new proofs and changing it if needed	20	3.50	.68	20	3.95	.75
9. In perceiving the difference between personal thoughts and scientific evidence	20	3.50	.88	20	4.10	.78
10. In having the basic scientific concepts of principle and theory	20	2.80	.76	20	3.60	1.14
11. In knowing where and how to find the needed knowledge	20	3.45	.75	20	3.90	.85
12. In reaching scientific knowledge	20	3.65	.74	20	3.95	.39
13. In using scientific means to reach knowledge	20	3.50	.82	20	3.85	.67
14. In using new scientific knowledge in daily life	20	3.30	.57	20	4.05	.68
15. In using scientific methods when making personal and social decisions	20	3.05	.82	20	3.65	.74
16. In using scientific methods (observation, classification, measurement, data recording, analysis, and so on) when solving the daily problems	20	3.25	.55	20	3.70	.65
17. In deciding whether the results will make any contribution to solving a problem	20	3.50	.82	20	3.80	.69
18. In designing scientific research (planning)	20	3.00	.72	20	3.30	.86
19. In executing scientific research through experimentations, observations, etc.	20	3.35	.58	20	3.45	.82
20. In accessing the required data for scientific research	20	3.45	.75	20	3.50	1.10
21. In assessing the results of scientific research	20	3.40	.68	20	3.65	.58
22. In following the latest scientific and technological developments	20	2.90	.64	20	3.55	.68
23. In benefiting from the latest scientific and technological developments so as to meet demands	20	3.10	.55	20	3.45	.88
24. In using scientific and technological knowledge to solve daily problems	20	3.20	.69	20	3.65	.93

Table 2
*The Items In The Scale of the Self-Efficacy Perceptions About Scientific Literacy and the Average Score
 Stems in The Survey of the Self-Efficacy Perceptions About Scientific Literacy and Average Scores*

Items	Pre-implementa- tion period			Post-implementa- tion period		
	n	X	SS	n	X	SS
25. In offering solutions to any social problem connected to science and technology, as a socially responsible individual	20	3.05	.39	20	3.70	.80
26. In understanding the difference between science and technology	20	3.60	.58	20	4.15	.67
27. In understanding the relation between science and technology	20	3.70	.65	20	4.20	.69
28. In understanding the interactions between science, technology, and society	20	3.70	.73	20	4.15	.71
29. In comprehending possible positive or negative impacts of scientific and technological applications on an individual, society, and the nature	20	3.50	.76	20	3.80	1.19
30. In cooperating with individuals and organizations to address the negative impact of scientific and technological applications on individuals, society, and nature, such as environmental pollution, global warming, and so on	20	2.90	.96	20	3.25	.71
31. In maintaining the science and technology education in real-life conditions through educational trips, studies, and observations	20	2.95	.68	20	3.30	.73
32. In participating in projects that focus on social problems resulting from scientific and technological developments	20	2.30	.65	20	3.00	.85
33. In encouraging others (such as local people, administrators and/or organizations) to participate in scientific and technological projects	20	2.80	.83	20	2.95	.68
Total	20	3.28	.68	20	3.75	.76

As is shown in Table 2, while the average response was 3.28 in the pre-implementation period, it rose to 3.75 after implementation. This shows that while the teacher candidates saw themselves as moderately capable before the implementation, they began to see themselves as quite capable following it. They found themselves moderately capable in 17 items before implementation, but this decreased to five items after it.

During the interview process, various questions were asked to determine the teacher candidates' self-efficacy perceptions of their scientific literacy in more detail. These questions and the quotations from the teacher candidates' responses to them are given in a consecutive order, i.e., the pre-implementation period precedes post-implementation.

Researcher: What are the characteristics of a scientifically literate individual? Considering these traits or characteristics, do you describe yourself as a scientifically literate person?

S2: I believe that *science literacy is knowing everything about science. I cannot describe myself as a scientifically literate person* as I cannot say I know everything about science. (Pre-implementation period)

S2: *A scientifically literate person knows herself/himself, her/his body, and her/his environment and understands what is going on in a more rational manner than others*

do. I have more of these capabilities more than I did before. So, I can say that I am scientifically literate. (Post-implementation period)

S5: Yes, I think *I am scientifically literate* because *I can assess and comprehend science and my life together*. (Pre-implementation period)

S5: *Scientific literacy is the ability to have curiosity about what is happening in the world, to produce sense and scientific reasoning about them and decide which of these reasons are accurate. A scientifically literate person is curious, asks questions, can think critically and has scientific skills, attitudes, and knowledge. I have these abilities.* (Post-implementation period)

S7: I do not know, *I am not sure*, because a *scientifically literate person can understand and interpret scientific processes...* I think *I am either scientifically literate or not*, because *it will be wrong if I say I am capable in all fields*. (Pre-implementation period)

S7: *A scientifically literate person is not satisfied with learning what is presented to her/him but has an attitude of searching and questioning how this knowledge was constructed. S/he expresses opinions about scientific issues. Yes, I believe I am a scientifically literate person. Although I do not have every capability, I question what is presented to me and try to get an idea of it.* (Post-implementation period)

The views of the teacher candidates on being a scientifically literate person differ between the pre-implementation and post-implementation periods. Before implementation of the viewing and discussing science-fiction films, they generally did not describe themselves as scientifically literate people, because they did not know all scientific subjects and concepts. However, all of them described themselves as scientifically literate people after the implementation. Thus, the teacher candidates who had not described themselves as scientifically literate persons ahead of implementation changed their views. Before implementation, only one teacher candidate made an error, saying it meant “knowing everything about science,” but others gave accurate, albeit partial, explanations. In the post-implementation period, the teacher candidates referred to the characteristics of scientifically literate people and then examined their own traits of characteristics. Although their explanations of the characteristics of a scientifically literate person did not give all traits or characteristics, their views included accurate qualities. The interview results showed that some teacher candidates did not see themselves as scientifically literate persons in the pre-implementation period, but they changed their views in the post-implementation period. This post-implementation result indicates that the teacher candidates had strong self-efficacy perceptions in this area, and thus this supports the result of the survey. As a matter of fact, the result obtained from the scale shows

that the teacher candidates' self-efficacy perceptions of their science literacy soared after the implementation process. The teacher candidates may have started to see themselves capable in this field after implementation because they related the movies seen to what they saw in their daily lives, interpreting these movies in this manner. Thus, the teacher candidates interpret science better when they build connections between their daily lives and science. Thus, their self-confidence in this area increases.

In the interview, the teacher candidates were asked to explain what connection exists between science, technology, and society. Quotations from their responses are given below:

R: What is the interaction between science, technology, and society?

S1: *Science nurtures technology.* Are technologies developed without new knowledge being found? (Pre-implementation)

S1: *As long as science develops, technologies do the same and this affects society.* (Post-implementation)

S3: I think *the society plays a pioneering role in technology development.* For *technology development, science is needed.* I mean there is a vicious circle between the two. (Pre-implementation)

S3: *Doing science creates a technological product. This technological product will make a contribution to society.* This product is made *so as to give the least ecological harm.* (Post-implementation)

S5: *I think they affect each other.* There is a sort of chain reaction between the two. (Pre-implementation)

S5: This includes a direct proportion. Anything *new in science makes a contribution to technology.* *The more progress technology makes, the more innovation is seen in science.* *Development in one of them fuels development or change in the other.* (Post-implementation)

S6: *Science affects technology, and the latter affects society.* I think their impact should be harmless. (Pre-implementation)

S6: *Science directs technology.* *Technological developments affect all societal sectors positively or negatively.* *The use of technologies by society has an impact on the natural environment.* (Post-implementation)

The teacher candidates here noted that there is a connection between science, technology, and society, and they gave different explanations of this relation both in the pre-implementation and post-implementation period. For instance, while some

teacher candidates stated only that science affects technology, others believed that science affects technology and technology affects society in the pre-implementation period. In the post-implementation period, the teacher candidates mentioned some common points, focusing on the pioneering role of science in technology and the impact of this on the society, and some candidates emphasized that technology is a process of creating products, and these products should not cause ecological harm. The findings obtained both ahead of the implementation and after this process showed that the teacher candidates can explain the connection between science, technology, and society in an accurate manner and they have awareness in this area. In fact, the teacher candidates demonstrated their capabilities in this field in their responses to the scale questions both in the pre-implementation and post-implementation period. Their efficacy levels were given a boost after the implementation process. The obtained findings thus support each other. This research result is related to the fact that the teacher candidates examined topics related to the movies and they discussed these in the classroom environment.

In another interview question, the teacher candidates were asked whether they use scientific methods in solving problems in their daily lives. The quotations from their responses both in the pre-implementation process and in the post-implementation process are given below:

R: Do you use scientific methods in making decisions in your daily life? Please explain how in an example.

S1: *I do not know what you mean by scientific methods.* However, I can say that *first of all I apply a logic filter when I make a decision about anything. I question and I thus reach my own answers.* (Pre-implementation)

S1: *I do not fully make use of them.* However, *I use some scientific stages. I reflect on how and why an incident happened, which problems there are here and then I try to solve them by making forecasts.* (Post-implementation)

S2: I certainly use them, or maybe I do not. *I do not know.* Sometimes I *question* things and try to *analyze* them. However, *I am not sure whether this is a scientific method.* (Pre-implementation)

S2: I do not use them too much. Actually, I do not notice this. I encounter many problems. I reflect on them just to find answers on a rational basis. I may be using the observation and hypothesis stages but I cannot say I fully use them. (Post-implementation)

S5: *Yes I do.* As soon as *we face a problem, we try different ways to solve it.* In the beginning of course, *we decide which ways we should apply.* After we try, *we find out*

which way is right to go. I mean, we have a problem. We seek solutions, we try and we reach a conclusion. Isn't that a scientific method? (Pre-implementation)

S5: We use them unconsciously. There are induction and deduction in science. For instance, we put ingredients in one by one when we make a cake. There is induction here. (Post-implementation)

S6: Yes I do. Aren't we solving problems every day? Willingly or unwillingly, we apply scientific methods to this. (Pre-implementation)

S6: Yes I do. Before starting something, I reflect on possible solutions to it. I set forth ideas about what they could be. This process can be related to making forecasts, which is a scientific method. (Post-implementation)

As it is evident, the teacher candidates had different views about how to use scientific methods in the pre-implementation period. While some said that they used scientific methods, some others noted that they had barely developed awareness in this area and could not give a sufficient explanation of whether they used scientific methods or not. In the post-implementation period, three teacher candidates mentioned that they used scientific methods in part, but others simply said they use them. Furthermore, some believed that they partially used scientific methods in the post-implementation period, although they were not aware of whether they used them. In the pre-implementation period, the candidates described the scientific methods they were using as passing things through a logic filter, questioning, trying different methods, and reaching conclusions. In the post-implementation period, it was evident that there was a difference in the scientific methods that were used by the teacher candidates, and that they first of all questioned incidents in a rational framework and used one or more of these stages. The candidates gave similar responses to the interview questions in the pre-implementation period as well. However, their responses in the post-implementation period showed that they could give detailed explanations of which scientific methods they used and that they could describe these scientific methods in detail. This result shows that people unconsciously use scientific methods in their daily lives. It also indicates they may use several of these methods. The candidates said that they used scientific methods in their response to the scale questions in both the pre-implementation and post-implementation periods; however, they said that they felt more capable in this area in their responses in the later period. In fact, their responses to the questions in the post-implementation interview showed that they had greater command of detail in this area than they had had in the earlier interview. Despite this, the data showed that some teacher candidates still felt only partially capable in this area. This shows more detailed studies are needed that will give more room for teacher candidates to voice their views. In this study, the teacher candidates' feelings of self-efficacy in using scientific methods were related to the consideration

of the scientific research process when movies were examined and awareness levels were attempted to be raised by prompting discussions in this area.

The teacher candidates were asked whether they feel capable to understand and interpreting scientific and technological things in their daily lives. Quotations from their responses in both the pre-implementation and post-implementation periods are given below:

R: Do you think yourself capable of understanding and interpreting scientific and technological things in your daily life? Please explain using examples.

S1: No *I do not think so. I cannot say I know everything about science.* (In the pre-implementation period)

S1: *I am not fully capable. However, the older I become, the more development I show in this area.* For instance, soap dissolves dirt in daily life. Polars dissolve polars and apolars dissolve apolars. Dirt is apolar, but water is polar. Therefore, water cannot dissolve dirt and apolar soaps are used. (In the post-implementation period)

S3: I can say *I am partially capable.* I learn new knowledge every day. I am showing development, willingly or unwillingly. I cannot fully explain what is happening in daily life, but I am sure *the older I become, the more I will be able to explain.* (Pre-implementation)

S3: *Yes I am sufficiently capable. In many things in my daily life, I make a connection with science, willingly or unwillingly.* For instance, we hear singing in our ears when we climb a mountain. (Post-implementation)

S6: Yes, *I think I am capable.* For instance, I recently explained to my mother why salt is added to pasta after it is cooked. *We have studied science for years. I think it works.* (Pre-implementation)

S6: *I am capable because I can make scientific and accurate explanations of what is happening around.* For instance, I understand it gets warmer when it snows because the water vapor heats the atmosphere when it freezes. (Post-implementation)

S7: *Maybe I can, but I am not sure. I might not be totally capable.* However, I believe *the more knowledge I get, the more sufficient I will become.* (Pre-implementation)

S7: *I partly do, although I do not fully.* I can interpret cancer studies in news releases or magazines. (Post-implementation)

The teacher candidates voiced different responses to the question in the pre-implementation and post-implementation periods. In the pre-implementation period, one teacher candidate thought herself/himself incapable, four of them thought

themselves partially capable and the others thought themselves capable. In the post-implementation period, three teacher candidates thought themselves partially capable of understanding and comprehending scientific and technological incidents and the others found themselves fully capable. Their views regarding the question were developed between the two periods. The teacher candidates who found themselves incapable and partially capable in the pre-implementation process emphasized that they had not learned everything about science yet. Those who found themselves partially capable spoke of their familiarity with scientific concepts that they had studied for years. In the post-implementation, the candidates who thought themselves partially capable said that they could make comments on scientific subjects in line with what they knew, although they could not grasp all information. The teacher candidates who thought themselves capable said that they could give rational explanations of what they saw around by relating it to science. All of the teacher candidates described themselves as scientifically literate in their answers to the first interview question. In this section, it was observed that some teacher candidates saw deficiencies in themselves. Although these two results seem to contradict each other, it the views need to be examined further. In their responses to a similar-scale question, it was found that the teacher candidates thought themselves capable in regards to scientific and technological issues in both the pre-implementation and post-implementation periods. In the post-implementation process, their capability levels increased. In spite of this, there were also some teacher candidates who thought themselves partially capable in the post-implementation interview. This shows that their views need further examination.

Teacher candidates were asked whether they saw themselves capable or not of designing a study and implementing it. Quotations from their responses are given below:

R: Do you think you can design and implement a scientific study? Please explain your process briefly.

S2: *Yes, I think I can. We are already doing this at school, aren't we? We observe, do research, interpret, and conclude.* (In the pre-implementation period)

S2: *Yes. I can design a study and implement it. I go through the various stages, including making experiments, observations, and recording data.* (In the post-implementation period)

S3: *Yes, of course I can. I help my sibling do studies.* (Pre-implementation)

S3: *Yes, I can. I have already done it. I first defined a problem, then I did a literature review, collected data, composed a hypothesis, and tested it by using the related data.* (Post-implementation)

S5: *I can*, of course. First of all, *I design the process*, I suppose. Then, *I implement it*. (Pre-implementation)

S5: *I do implementation*. For instance, are there genetically modified organism in Turkey's grain? I collect a series of grains of different type. Then, I examine them in a laboratory environment and reach a general conclusion. (Post-implementation)

S7: *I cannot*. How could I, because I do not know all the scientific information. I think *it would be difficult for me to execute a research process*. (Pre-implementation)

S7: *I do not think I can create a study and implement it by myself at my existing knowledge level*. (Post-implementation)

The teacher candidates gave parallel responses in both periods and they generally mentioned that they thought themselves capable of doing scientific research. In the pre-implementation period, only one of the teacher candidates commented on the research process and mentioned a number of stages, including making experiments, doing observations, and recording data. In the post-implementation period, the teacher candidates were able to go into greater detail about the research process than they had been earlier, and that they said they could conduct a study by going through the different stages, including composing a hypothesis, doing literature review, making experiments, and observations, and collecting and recording data. This shows that the candidates believed that there are such things as particular scientific stages, but they may have a misconception here. Teacher candidates may have seen themselves capable in this area because of their predictions of the scientific research processes in the movies which they have watched.

In another interview question, the candidates were asked to say whether they would be able to enable their students to comprehend the parts of scientific literacy, such as knowledge of the nature of science and scientific attitudes and process skills. Quotations from their responses in both the pre-implementation and post-implementation periods are given below:

R: Do you think you can teach your students the parts of scientific literacy, such as the nature of science and scientific attitudes and skills?

S1: *No, I do not think so. I actually can enable them to be scientifically literate, but I am not sure about getting them to learn the parts of scientific literacy*. (In the pre-implementation period)

S1: *Yes. I want them to define what science is and I can enable them to learn by telling them what a scientist experiences in making an invention and what kind of environment s/he realizes this in*. (In the post-implementation period)

S2: *Yes, I do. I know what scientific literacy is and which characteristics a scientifically literate person has.* In this vein, I think I can do it. (Pre-implementation)

S2: *Yes, I can.* It might be beneficial to get students' attention by asking thought-provoking questions and thus to stimulate them to explore. (Post-implementation)

S4: *Yes, I do. Thanks to the department in which I am studying, I believe I have the required qualities to be a scientifically literate person.* I also see how these qualities are used in my classes. I do not think I will face a considerable problem. (Pre-implementation)

S4: *Yes. I can get them to make experiments* and to adopt different ways of doing experiments for each one. (Post-implementation)

S5: *Yes, I can.* Isn't it our aim to make them to attain this? (Pre-implementation)

S5: *In order to be able to teach the nature of science to students, we need to adopt a scientific attitude. In doing this, we need to use skills related to the scientific process. I believe I can get them to learn.* We can best achieve this by emphasizing the issues that must be considered or questioned by students when performing applied science in the classroom. (Post-implementation)

While all teacher candidates answered the above question before the implementation, three of them chose not to answer it in the post-implementation. One of the respondents in the pre-implementation believed s/he could not get students to attain scientific literacy as s/he did not have enough knowledge regarding its parts. The remaining teacher candidates said that they could do this as they had the appropriate characteristics due to the nature of the department in which they were studying, and these characteristics were already being taught to them. However, they did not say about what uses they would employ. The teacher candidates who responded to the question in the post-implementation period mentioned that they could make their students master related topics. The teacher candidates planned to use different means, including doing experiments, questioning, conducting research, and making students define what science is to achieve their goals. The scale results also showed that the candidates found themselves capable of getting their students to reach the required concepts. Their capability levels had increased by the post-implementation period. It is believed that the teacher candidates' levels of capability in this area should be examined further in the light of the fact that they had not studied related concepts, as they were early in their training and that they had not discussed them when the movies were reviewed.

The teacher candidates were asked whether they distinguish between what science is and what so-called science is. The quotations from their responses in both the pre-

implementation and post-implementation periods are given below:

R: Do you find yourself capable of differentiating what science is and what so-called science is? Please explain what your criteria are with examples.

S1: *Yes* I can, I suppose. Aren't we doing this in our daily lives? (In the pre-implementation period)

S1: *Yes*, I believe I have this capability. While *science* explains the incidents in daily life by means of *scientific data*, so-called science does not use any scientific data. *So-called science exploits people's weaknesses and needs*. For instance, some herbs whose effects are not supported by any proof are used as medicine under the name alternative medicine. (In the post-implementation period)

S2: I guess I can. For example, fortune telling is not a science. Its effects cannot be discussed and are prone to change. Using these facts, we can comment about other fields as well. (Pre-implementation)

S2: Science is based on robust foundations, namely *on data and results obtained from several experiments*. *So-called science does not include these stages*. This is seen in alternative medicine. (In the post-implementation process)

S5: I do. First of all, I must *conduct research*. Then I should *generalize its conclusions* and *make a decision*. (Pre-implementation)

S5: Science is based on certain foundation. To call something a science, it must be founded on many experimental and observational conditions. So-called science is born from the comprehension of some conditions. For example, all people who suffer from headache are not given the same medicine. We should first learn what the reason behind the ache is. (Post-implementation)

All teacher candidates saw themselves capable of differentiating science from so-called science, in both the pre-implementation and post-implementation periods. They mentioned several criteria to differentiate science from so-called science, including discussing results, making generalizations, and being prone to change, in their pre-implementation responses. In the post-implementation, they focused on different criteria, such as the reliance on scientific data and the presentation of scientific proof. The scale results also indicated that the teacher candidates found themselves capable of making this differentiation, and their capability in this area received a boost in the post-implementation process. This result may be related to the fact that this and related topics were given a place in the implementation course.

It is clear from the results of the survey and interviews that the teacher candidates' capability levels on the scale items had improved, but some teacher candidates

thought themselves partially capable or with some deficiencies in their responses to the interview questions. As a matter of fact, no difference was detected in the teacher candidates' capability levels in certain areas following the implementation process, including designing a study, the maintenance of scientific and technological issues in real circumstances, participation in projects that include social problems resulting from scientific and technological issues, encouraging others to participate in such projects, and cooperating with individuals and organizations to solve problems resulting from scientific and technological application.

Was There any Difference in the Science Teacher Candidates' Self-Efficacy Perceptions Regarding Their Scientific Literacy Following the Implementation Process?

The findings for whether there was any difference in the teacher candidates' self-efficacy perceptions of their scientific literacy levels following implementation are given in Table 3.

Table 3
T-Test Results Retrieved from Pre-Implementation and Post-Implementation Data

Measurement	N	X	SS	Sd	t
Before implementation	20	108.1	13.289	19	4.29
After implementation	20	123.6	16.158		

A significant difference was observed in the teacher candidates' scores on the scale that measured their self-efficacy perceptions of their scientific literacy levels between the pre-implementation and post-implementation periods ($p = .000$). Furthermore, the average scores also increased following implementation.

Discussion

This study found teacher candidates' self-efficacy perception levels of their scientific literacy were at "moderately capable" in the pre-implementation period, but this level rose to the "quite capable" level following implementation. Saracaloğlu et al. (2013) and Caymaz (2008) also sought to determine on what levels science teacher candidates' self-efficacy perceptions of their own science and technology literacy were in their studies. The results of both studies showed that the perceptions of these teacher candidates reached the "quite capable" level. This study found that while the subject teacher candidates' perception levels were at the "moderately capable" level ahead of the implementation, they improved after the implementation. In fact, there was a significant difference in the scores of the teacher candidates on the self-efficacy perception scale on the scientific and technological literacy between pre-implementation and in post-implementation. The perception levels of scientific

literacy in the pre-implementation process were lower than those found in the literature because of these teacher candidates' levels (early in their training). There have been several studies that show a relation between class level and self-efficacy levels (Aslan & Uluçınar Sağır, 2008; Chester & Beaudin, 1996; Önen & Öztuna, 2005; Yaman, Cansüngü Koray, & Altunçekiç, 2004).

The teacher candidates found themselves “moderately capable” for 17 items in the pre-implementation period, but the number of items decreased to five in the post-implementation period. This shows that they started to see themselves as capable in larger number of items. Further, no difference was not detected in their capability levels in certain areas following implementation, including the designing a scientific study, the maintenance of scientific and technological issues under real circumstances, participation to projects that include social problems resulting from scientific and technological issues, encouraging others to participate in such projects and cooperating with individuals and organizations to create solutions to problems resulting from scientific and technological applications. This results from several factors, including the closeness of certain scale topics to the scientific applications, the limitations of the teacher candidates in putting these topics into practice due to their class level and the inability to examine topics related to the movies in a sufficient manner. In general, the results of this study show that science-fiction movies have a positive impact on the development of the teacher candidates' self-efficacy levels of perception of their scientific literacy.

In addition to the scale results, interview findings were also given. All the teacher candidates interviewed described themselves as scientifically literate people, and defined by them as those who can comprehend what is around them in a rational manner and understand it with scientific reasons.

In sum, the interviewed teacher candidates described themselves as scientifically literate. Their beliefs in this area showed that they had high self-efficacy perception levels of their scientific literacy. The results of the post-implementation survey also indicated that the self-efficacy perceptions of the teacher candidates advanced in the post-implementation process. Their beliefs may have improved because they related what happens in the movies that were screened to what they have faced in their lives and they could understand and comprehend what science, receiving a boost to their self-confidence. Although the study's results showed that the teacher candidates thought themselves capable and had high self-confidence levels, this could lead to problems in teaching. Teachers who have self-confidence levels that are too high and who finds her/himself too capable of doing things may not be able to discover possible deficiencies in her/his store of knowledge both in the teaching field and in pedagogic area. The teacher candidates in this study mentioned their deficiencies

in their responses to the interview questions and they did not change their stance on some scale items even after implementation. In this context, further positive contribution could be made if steps are taken to determine which deficiencies teacher candidates have when their qualities based on their beliefs, such as their self-efficacy levels, are intended to be developed.

The teacher candidates also expressed that they found themselves “quite capable” of understanding the interaction between science, technology, and society in their scale responses. Additionally, in interviews, they said that science gives direction to technologies and this affects society. Furthermore, the teacher candidates believe that technology is a development process of products that should not harm the natural environment. These results seem to be in parallel to several results in the literature. In a study of Uğraş and Cil (2012), the science teacher candidate subjects mentioned that science and technology develop each other. In a study by Çınar (2013) of a group of preschool teachers, study participants said that technology does not have its own knowledge base, so it is dependent on science, and that social values and ecological issues constitute critical factors when technologies are created. The results from various other studies show that there is a relation of a continuous chain between the three factors, namely science, technology, and society. This study showed that the teacher candidates had accurate ideas about the science–technology–society relation and that they understood this connection in a proper manner. This is believed to be due to the fact that the teacher candidates discussed related themes when they viewed the movies in this study and/or that they examined related topics in the scope of the class which they were taking.

A study by Özdemir (2010) suggested that science and technology teacher candidates grasped the science–technology–society relation in general terms, but they could not understand scientific concepts, and concluded that the understanding of teacher candidates on the science literacy and its phenomena, concepts, and principles was nothing but an artificial awareness. In other words, that study found that teacher candidates did not understand the nature of science in an appropriate manner. Thier (1985) noted that students generally have a lower knowledge level in regard to any problems based on the relation between science, technology, and society (Thier, 1985 as cited in Turgut & Fer, 2006). The results of this study indicated that the teacher candidates had a good level of knowledge in issues relating science, technology, and society, but it did not create enough data on how much these candidates use or can use this knowledge in their daily lives. This shows that more studies are needed in this area and that students need to be made interact more with daily life to develop their levels of knowledge and awareness.

Furthermore, in their responses to the survey after implementation, the teacher candidates said that they found themselves “quite capable” of using scientific

methods and comprehending scientific and technological issues in their daily lives. This result may be related to the discussions held on scientific research related to the selected movies. Even if the result was positive, the interviews of the teacher candidates allowed us to conclude that they found themselves incapable or partially capable in this area. This indicated that further studies to determine in more detail teacher candidates' views on this issue are needed.

The teacher candidates found themselves “quite capable” of differentiating science from so-called science and teaching the nature of science, scientific attitudes, and scientific skills in their responses to the scale questions. Similar results were also attained in the interview. The teacher candidates focused on various criteria, including the reliance on scientific data and presenting experimental evidence, in making a differentiation between what science is and what so-called science is. In teaching scientific attitudes and process skills, they noted that they could concentrate on several activities, including doing experiments and questioning and defining what science is. This result is positive and shows that the teacher candidates had high levels of self-efficacy perception in this area. That this may fuel the motivation of the teacher candidates when they start to teach, but would also pave the way for some mistakes. When the teacher candidates' class levels are considered and it is taken into consideration that they were not yet familiar with some key concepts, such as the nature of science and the scientific attitude and skills, and that the mentioned concepts had not been examined when the research movies were reviewed, the capability levels of the teacher candidates in this area may lead mistakes in their teaching.

Moreover, in their responses to the survey questions after implementation, although the candidates said that they found themselves “moderately capable” of designing a scientific study, they described themselves “quite capable” of conducting such studies. This difference may have resulted from the fact that the teacher candidates did not have enough experience in planning a scientific study, as they were in lower class, but they had actually been directly involved in scientific research and become more or less familiar with scientific concepts as they sought solutions to their daily problems. In interviews, teacher candidates said that they thought themselves quite capable of designing and conducting a study. This difference may have occurred because the interview question aimed at covering the research process in general rather than at digging into further details. During the interviews, the teacher candidates were also asked to explain how to make their students conduct a study. The teacher candidates stated that they believed that any scientific study is done in certain stages, showing possible misconceptions in this area.

Taken together, the results obtained through all data collection tools show that the teacher candidates' self-efficacy perception levels of their scientific literacy developed

following the implementation of the study. In spite of this, the interview data also showed that the teacher candidates felt incapable in some areas as well. This shows that any topics directly related to people's beliefs and experiences, including their self-efficacy levels, should be examined in more detail through various data collection tools.

The candidates made presentations after they had watched the study movies and thus learned how to use movies as an educational tool as well as a means of entertainment. They examined these movies in the context of the science–technology–society relation. In this way, the teacher candidates gained knowledge and experience of what scientific literacy is, and their belief in educating scientifically literate people have strengthened. In their study, Önen and Muşlu Kaygısız (2013) found that teacher candidates who were given the chance of applying activities and experiencing direct teaching received several positive contributions, including “taking responsibility for teaching, taking on the teaching profession more and gaining teaching experience.” Similarly, a study by Özdemir (2008) on 223 classroom teacher candidates showed that it is a must for teacher candidates to gain knowledge and skills on how to apply and assess teaching activities to boost their self-efficacy perceptions. Bandura (1986) also stated that experiences fuel self-efficacy beliefs. Various studies have emphasized that individuals' experiences matter in the development of their self-efficacy beliefs. People gain experience throughout their lifetime through both classroom activities and daily life activities.

Educating scientifically literate individuals is an indispensable goal of today's modern educational system and various teaching programs are being revised to achieve this goal. Finding interest and need in the education and teaching depends on people's individual characteristics and the quality of the offered teaching system. The level of success in developing scientific literacy among students remains low in Turkey despite many reforms to achieve it. The results of the 2012 PISA tests indicated that although the percentage of Turkish students at the lowest “level 1 and below” level in science literacy had decreased, it was still much higher than the OECD average (The Ministry of National Education, 2013). This shows the great need for reform in Turkey to be planned so as to include different perspectives, to be more in compliance with today's circumstances, and to take personal differences into consideration. Fife (1999) noted that students tended to read less day by day, and they respond better to visual presentations rather than reading texts. Shaw and Dybdahl (2000) wrote that students learn through informal as well as formal ways. Various studies indicate that learning and teaching processes should be designed to attract students' attention to a greater degree. Movies, as a tool to this end, enable students employ a critical and scientific perspective, according to Lin et al. (2013). Barnett et al. (2006) showed that a wider representation of scientific issues in television productions or movies draws the public's attention to such issues. Because science-fiction movies focus on many different scientific, technological, social, and environmental issues in addition to

various concepts in natural science, they can serve as quite effective teaching materials, especially in natural sciences class. Ekem (1990) found that science-fiction movies had a positive impact on people's attitudes toward the natural sciences and their personal development (Ekem, 1990 as cited in [Buluş Kırıkkaya et al., 2009](#)). [Yazıcı and Altıparmak \(2010\)](#) also found that science-fiction movies enabled students increase their academic success and adopt positive attitudes, especially toward biotechnology and bioethics. [Laprise and Winrich \(2010\)](#) stated that science-fiction movies can also be pedagogic tools to fuel students' motivation toward the natural sciences and increase their critical thinking on science concepts. [Sürmeli \(2012\)](#) noted that science-fiction films develop people's skills of imagination, problem-solving, comprehension, using scientific processes, and science literacy.

The study has shown that science-fiction movies have a positive impact on people's self-efficacy perceptions of their scientific literacy. This may be related to the fact that students examined science-fiction movies, which they had already seen in their daily lives, from a different perspective during their study, that they considered them in the context of key elements of science literacy, and that their awareness of their levels of science literacy and beliefs about teaching science gradually strengthened. In their study on a group of high school chemistry teachers, [Blonder et al. \(2013\)](#) developed teachers' self-efficacy perceptions of the science of chemistry by means of videos. In that study, teachers first watched ready-made YouTube videos and then they made their own videos within the framework of their discipline. It was found that the self-efficacy perception level of these teachers was strengthened following the implementation of that study. That result is parallel to the results of the present study.

As can be seen in many examples in the literature, viewing science-fiction movies, an informal method of learning, can have positive impact on learning processes. The study has found a new contribution of these movies to people's learning processes. At what level this contribution will flourish and how it will shape teaching will bring key responsibilities to the teachers who will direct its application. Educating a sophisticated individual depends on the effectiveness of the teacher. A sophisticated teacher, who has participated in in-service teaching programs and who loves both her/his profession and students, will educate students as s/he has been educated. Therefore, teaching faculties work to educate teachers of high quality with various skills. Thus, academics in these faculties should have a rich knowledge base and various skills and experiences and should create a fertile environment for their students, transferring these experiences to them and to enabling them to encounter similar experiences. In this vein, as a conclusion, it is suggested to:

1. use teaching materials that are integrated with new technology, will make students more active, and combine daily life issues and science topics more, in all areas of teaching;

2. give a greater place to science-fiction movies and visual materials to increase students' interest and enable them to gain various skills with the help of these materials;
3. plan classes to create fertile ground for teacher candidates to try new things to increase their self-efficacy perceptions;
4. elaborate future studies on self-efficacy perception levels to collect qualitative data in larger numbers and create findings in more detail, rather than focusing mainly on quantitative data collection tools; and
5. create comparative studies by applying the same implementation in different class levels.

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