TEACHER CANDIDATES' EVALUATION OF THE FRINGE SERIES IN THE SCIENCE-TECHNOLOGY-SOCIETY TRIANGLE

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ABSTRACT

It is widely accepted that one of the most important series that sheds light on the triangle of science-technology-society is the Fringe series. This study intends to make teacher candidates analyze the Fringe in the triangle of science-technology-society and to get their views on the future technologies mentioned in the series and the dilemmas about the effects of these technologies on society. The phenomenology method, one of the qualitative research methods was used when designing the study. During the application process, the teacher candidates were shown the Fringe series and based on the science and technology applications in this series as well as the effects of these applications on society, the existing phenomena related to the subject in the context of science-technology-society were examined. Semi-structured interview questions for the Fringe developed by the researchers were used as a data collection tool. As a result of the study, it was seen that the science teacher candidates evaluated the events in the Fringe with different perspectives on the science-technology-society triangle.

Keywords: *Fringe, Science, Technology, Society, Teacher Candidates*

INTRODUCTION

Survival in the age of science and technology obliges individuals to solve many problems and cope with various risk situations. Most of the time, individuals need to use science and technology to find solutions to the problems they are dealing with. On the plus side, driven by exigency, all countries are trying to develop/invent new technologies. Every new day gives birth to a scientific development or a new technology, allowing people more room for interaction with new technologies (Önder & Güven Yıldırım, 2020). Advances in science and technology coupled with the rapid adoption of technological novelties play an important role in the economic, social and environmental progress of societies (Ahmed & Stein, 2004).

Today, new science and technologies are developed in many fields such as biotechnology, stem cell technologies, nanotechnology, space technology, nuclear technology, artificial intelligence, genetically modified organisms, robotic applications. It is critical for the individuals who make up societies to be aware of how to develop and change science and technology and how to apply them in the light of these practices, both for the welfare of future generations and for ensuring the continuity of life on earth (ITEA, 2006). Because these practices open extraordinary windows of opportunities for people on one hand, while on the other hand, leading to anxieties about the future, worries and uncertainties, causing people to have dilemmas with regards to these practices. The decisions and attitudes of individuals with these dilemmas also affect the adoption of these practices by societies. Therefore, it is of great importance how we act and make decisions in the face of dilemmas brought about by scientific and technological developments. It is necessary to analyse the positive and negative aspects of each application, to present the analysis in the light of scientific data and to make informed decisions. These processes may require the use of high-level thinking skills such as critical/creative thinking, informal reasoning and argumentation. As a result, in order for these skills to be taught and for individuals to make informed decisions, students should be encouraged to face dilemmas and actively experience decision-making processes in education and training processes (Atabey & Topçu, 2020). One of the important helpers that can provide support in educational environments is media and communication technologies. As mass media tools such as television and computers have an important place in children's lives coming to the fore as environments where informal science education is provided to children (Dierking et al., 2003). Therefore, it is thought that utilizing science fiction movies and TV series can be effective in decision-making processes for dilemmas brought about by scientific and technological developments. Because works of science fiction can be put to active use in the teaching of socio-scientific issues and scientific concepts in that they tend to dwell on the relations between science and society (Knippels, Severiens, & Klop, 2009). In this context, it is seen as an undeniable fact that science fiction can an important tool in a society where the new generation is tasked with leading the society, and it is assumed that universal values that can be brought around and tied up with science fiction might lead to the raising of inquisitive and creative minds of the future (Karagöz, 2015).

Science fiction, based on positive science, explains what science will look like in the future using the medium of art and literature (Bayar, 2001). One of the most important elements on which science fiction is based is that human beings benefit from technology for the solution of all kinds of problems, have confidence in science and technology, do not think that technology is good or bad on its own, and know by whom and for what purpose the new technologies are used (Çelik, 2017). Science fiction cinema covers many topics such as extra-terrestrial beings, other universes, disaster scenarios about the end of the world, dystopias, time travel and artificial intelligence, as well as making predictions about the future of humanity (Yılmaz & Turan, 2018). It is stated that one of the most important series that includes these subjects and sheds light on the triangle of science-technology-society with its subject is the Fringe series (Güven Yıldırım et al., 2022). Fringe has attracted and still attracts the attention of a large audience as a series that questions the universe, time, existence, and the effects of science and technology on society. Almost every episode of the series contains references to the relationship between science and technology, future technologies, and the effects of science and technology applications on society and order. In most of the episodes, a dilemma arises about the effects of a technological development or a scientific leap on society, and the effects of these dilemmas on both this world and on the parallel universe are presented to the audience. Based on these dilemmas, the audience is given a window of perspective with which to look at the future on the basis of the triangle of science-technology-society employing scientific thinking and scientific reasoning skills. This study intends to make teacher candidates analyze the Fringe series in the triangle of science-technology-society and to get their views on the future technologies mentioned in the series and the dilemmas about the effects of these technologies on society. How do teacher candidates evaluate the Fringe series in the science-technology-society triangle? This question was determined as the research question of this study.

METHODOLOGY

The phenomenology method, which is one of the qualitative research methods was used in designing

the study. During the application process, the teacher candidates were shown the Fringe TV series and based on the science and technology applications in this series as well as the effects of these applications on society, the existing phenomena related to the subject in the context of science-technology-society were examined. Phenomenology studies how people perceive and make sense of phenomena and their experiences, how they describe, how they remember, how they evaluate and how they communicate them to other people (Patton, 2002). In this study, researchers are interested in the subjective experiences of teacher candidates watching the TV series to study the effects of the TV series on their personal thoughts in the context of science-technology-society. For this purpose, interviews were held with the participants and their views on the subject were examined in detail.

Study Group

The participants from whom the data were collected were determined by the convenience sampling method (Cohen, Manion, & Morrison, 2007). With convenient sampling, researchers select volunteering participants who are easy to reach, and suitable for the research (Gravetter & Forzano, 2012). For the purpose of this study, the researchers selected as the study group science teacher candidates studying at Gazi Education Faculty to ensure easy accessibility. Before the study, general information about the study was given to the students, the study process was explained, and participation was entirely on a voluntary basis. The study group of the research consisted of forty-three 2nd year teacher candidates studying at the Science Teaching Department of Gazi Education Faculty in the fall semester of the academic year 2020-2021, who agreed to take part in the study.

Data Collection Tools

In the study, 4 semi-structured interview questions for the Fringe series developed by the researchers were used as a data collection tool. Interview questions for the candidates were first presented to an expert group working in the field of science education and measurement and evaluation, and necessary arrangements were made to the questions in line with the feedback received. In the study, the following questions were asked to the teacher candidates;
1. What can you say about the character of Walter Bishop in terms of the characteristics that a scientist should have?
2. When you watched the series as a science teacher candidate, did your views on physics, chemistry and biology applications/technologies change? Why?
3. What do you think about the effects of the actual use of scientific applications/technologies mentioned in the series, which are not yet available yet, on society?
4. If you had the power to use all the applications and technologies described in the series, which application/technology would you use and to what end?

Later, an interview form was prepared to be used during the interviews and the pattern in this form was followed during the interviews. All data obtained from the interviews were recorded with a voice recorder to convert them into written text, after obtaining the consent of the participants. Since the teacher candidates' own sentences are given directly in the results, each teacher candidate was given code names such as T1, T2, T3…

Collecting Data

In the research, it was decided to use the Fringe series as a teaching material. In the selection of the series, its science-based scenario, its questioning of the universe and time with scientific elements, and the examination of the effects of science and technology on society played a role. In the study, first of all, general information about the series was given to the teacher candidates and they were asked to watch the series during an academic semester. At the end of the specified period, semi-structured interviews were conducted with each teacher candidate. The interviews were recorded with the permission of the participants and afterwards they were converted into written texts in a computer environment.

Data Analysis

Content analysis, which is one of the qualitative data analysis methods, was chosen for the analysis of the data. Content analysis is a systematic technique in which some words of a text are summarized with smaller content categories with coding, adhering to a certain set of rules (Büyüköztürk et al., 2021). In the analysis of the qualitative data obtained from the research, the stages specified by Miles and Huberman (1994) and Yıldırım and Şimşek (2016) were followed. As a first step in qualitative data analysis, the data were converted into written documents. In the next step, an interview coding key was created and codes were created around themes under which the data would be organized and issued. Afterwards, the coded expressions were rearranged according to their similarities and differences and transformed into themes. After the themes were obtained, tables were created showing the themes, codes and how often students uttered codes.

FINDINGS

The data pertaining to the answers given by the teachers to the semi-structured interview questions are presented in the tables below. Firstly, the teacher candidates were asked, 'What can you say about the character of Walter Bishop in terms of the characteristics that a scientist should have?' The code, theme and frequency values for answers given by teacher candidates are given in the Table 1 below.

Table 1.
Opinions on the Character of Walter Bishop in Terms of the Characteristics That a Scientist Should Have

Theme	Code	f
Personal characteristics	Creative	41
	Curious	37
	Ambitious	29
	Eager	21
	Open minded	13
	Enthusiastic	13
	Free-spirited	7
	Crazy	2
Occupational characteristics	Does research	33
	Questions	29
	Solves problems	29
	Makes observations	20
	Does not avoid discussions	18
	Cares about self-development	11
	Makes inferences	5
	Open to learning	3

When Table 1 is examined, teacher candidates evaluated the character of Walter Bishop in terms of the characteristics that a scientist should have, with the answers gathered under two themes, personal and professional characteristics. When teacher candidates talked about Bishop's personal characteristics, they said he was creative (f=41), curious (f=37), ambitious (f=29), eager (f=21), open-minded (f=13), enthusiastic (f=13), free-spirited (f=7) and crazy (f=2). As for the theme of professional characteristics, teacher candidates defined Bishop as someone who does research (f=33), questions things (f=29) and solves problems (f=29). They also said Bishop was someone who observes (f=20), does not avoid discussions (f=18), cares about self-development (f=11), makes inferences (f=5) and is open to learning (f=3). Direct quotations from the teachers' responses to the question are given below:

T₃: 'Walter Bishop as a person aroused different sentiments inside me. While watching the series, I was very angry with him on one hand, but I also appreciated his being a scientist. He is an incredibly creative and enthusiastic person. He is constantly researching, trying to solve things and is also very ambitious. He tries to solve each case that comes his way, always trying to find something new.'

T$_{27}$: 'His most outstanding feature is that he is definitely very creative and eager. He observes everything down to the smallest detail and is always trying to learn something new.'

T$_{39}$: '…In fact, he is not your usual scientist. A free-spirited person that is above clichés. He questions everything, he even argues with himself, at times.'

After the first question, the teacher candidates were asked, 'When you watched the series as a science teacher candidate, did your views on physics, chemistry and biology applications/technologies change? Why?' The codes and themes obtained from the answers given by the teacher candidates are given in Table 2.

Table 2.
Opinions on Physics, Chemistry, Biology Applications/Technologies

Theme	Code	f
Changed in a positive way	I understood how a scientist thinks	27
	I understood the nature of science	23
	I learned about physics, chemistry, biology	21
	I developed an objective view of science	17
	I became aware of the daily life applications of science	15
	I realized that science is present in all aspects of our lives	11
	I learned the relationship between different fields of science	9
	I understood the relationship between science and technology	9
	I felt the desire to produce new ideas and projects	5
	I felt the desire to do research and read	2
Changed in a negative way	I began to be skeptical of some applications of science.	10
	I realized how terrible biological and chemical weapons are	9
	I've seen how people can abuse their power for their own selfish ends	7
	I realized how technology can lead to bad consequences in the hands of malicious people	7
	I realized that ethical values can quickly disappear.	3
	I have seen that there can be experiments with human subjects	2
	I realized that science has no limits	1

Table 2 illustrates the codes and themes regarding the change in the views of teacher candidates on physics, chemistry and biology applications/technologies after watching the series. It was observed that teacher candidates reported codes indicating that their views changed positively and negatively after watching the series. Under the theme of positive change of views, teacher candidates mostly said they understood the way of thinking of scientists (f=27) and the nature of science (f=23), learned physics, chemistry and biology (f=21), developed an objective point of view towards science (f =17) and they became aware of the daily life applications of science (f=15). Under the theme of a negative change of views, teacher candidates mostly said that they started to become suspicious of some applications of science (f = 10), that they understood how terrible biological and chemical weapons were (f = 9), and that they saw how people could abuse their power for their own selfish ends (f=7). Direct quotations from the teachers' responses to the question are given below:

T$_{19}$: '…I revisited the subjects of physics, chemistry and biology once again, it was as if I had learned it all over again. In a way, I had a better grasp of the nature of these sciences. But I also thought that science has no limits.'

T$_{32}$: '…I actually got very agitated and I look at new technologies with suspicion right now. Because I've seen what can happen if these technologies are used by bad people. How many people could those biological and chemical weapons kill, for example, if they could be used in real life. In other words, I think it is more important who owns the technology.'

T_{41}: '…it did change indeed. I think it bothered me the most that there were human subjects.'

Afterwards, the teacher candidates were asked, 'What do you think about the effects of the actual use of scientific applications/technologies mentioned in the series, which are not yet available yet, on society?'. The codes and themes obtained from the answers given by the teacher candidates are given in Table 3.

Table 3.
Opinions on the Effects of Actual Use of Scientific Applications/Technologies That Are Not Available Yet Used by Society

Theme	Code	f
The use of applications / technologies in real life positively affects society	With teleportation, it is easier to go from one place to another	22
	Artificial organ production saves many lives	20
	Toggling between parallel universes is the solution to the scarcity of resources	13
	Many diseases can get treated very quickly with new generation smart drugs.	13
	AI does all the day-to-day work for us	8
	Time travel allows us to see the past and the future.	4
	Many cases can be solved with brain reading.	2
	Science evolves, the universe expands	1
The use of applications / technologies in real life negatively affects society	Teleporting technology brings chaos with it	13
	Biological/chemical weapons bring the end of humanity	12
	Travel between universes causes alien invasion	6
	Ethical values disappear	5
	Mind control poses a threat to free thought	3
	More people are used in experiments	2

Table 3 illustrates the views of teacher candidates on the effects of actual use of scientific applications/technology that are not available yet on society. Answers given by teacher candidates can be gathered around two themes, namely negative or positive effects of actual use of applications/technologies on society. Under the theme of positive effects on society, teachers' candidates stated that it would be very easy to go from one place to another with teleportation (f=22), that artificial organ production would save many people's lives (f=20) and switching between parallel universes would be a solution to the scarcity of resources (f=13) and that many diseases would be treated very quickly with new generation smart drugs (f=13). Teacher candidates holding negative views stated that teleportation technology would bring chaos (f=13), biological/chemical weapons would bring the end of humanity (f=12), transition between universes would cause alien invasion (f=6) and ethical values would disappear (f=5). Direct quotations from the teachers' responses to the question are given below:

T_{11}: '…I think it would be really nice. Transport would always be much easier with teleportation. There would be no air pollution. There are also some new lines of drugs in the series. If we could use them, it could be a cure for many diseases.'

T_{16}: '…If we had the technologies in the series, it would have a very bad effect on society. For example, teleportation… People would just move around at their own will, how would you control it? And if things could be teleported from other universes, beings from other planets would invade the world.'

T_{21}: 'I wish we had them at our disposal. We would develop artificial organs, the lives of many people waiting for organ transplants would be saved, diseases would be treated immediately. I would also like to go to parallel universes. From there it would be possible to bring everything needed in the world and to learn new technologies.'

Finally, teacher candidates were asked, 'If you had the power to use all the applications and technologies described in the series, which application/technology would you use and to what end?'. The codes and themes obtained from the answers given by the teacher candidates are given in Table 4.

Table 4.
Opinions on Which of the Applications and Technologies Described in the Series Would Use and to What End

Theme	Code	f
Solving social problems	Teleportation	23
	Switching between universes	17
	Time travel	11
	Nano technological environment/matter/tool production	9
	Checking power tools	7
	Preventing earthquakes with vibration control	2
Putting an end to diseases	Artificial organ production	20
	Smart drug production	18
	Producing transgenic beings	11
	Gene replacement	11
	Stem cell isolation	4
	Cell regeneration	1
Personal development	Teleportation	18
	Mind reading	12
	Mind control	10
	Seeing the future	5
	Shapeshifting	2
	Communicating with telepathy	1
	Communicating with the dead	1

When Table 4 is examined, teacher candidates' views on to what end it would be if they had the power to use all the applications and technologies described in the series, are gathered around the themes of solving social problems, putting an end to diseases and personal development. Under the theme of solving social problems, most of the teacher candidates stated that they would use the power of teleportation (f=23) and switching between universes (f=17). Under the theme of ending diseases, teacher candidates stated that they would mostly use artificial organ production (f=20), smart drug production (f=18), transgenic being creation (f=11) and gene replacement (f=11) technologies. Direct quotations from the teachers' responses to the question are given below:

T_1: '...I would definitely use teleportation. I would be something like a superhero. I could go wherever I wanted, whenever I wanted, in seconds. If I had the power, I would love to see the future.'

T_{29}: 'I would like to do time travel. It would be possible to go both into the past and into the future and fix everything in the present. I would love to be able to teleport.'

T_{37}: '...I would work on stem cells; I would try to renew the cells. I would try to find cures for diseases.'

DISCUSSION AND CONCLUSION

This study intended to make teacher candidates analyse the Fringe series in the triangle of science-technology-society and to get their views on the future technologies mentioned in the series and the dilemmas about the effects of these technologies on society. The findings of the study were obtained by analysing the answers given by teacher candidates to the semi-structured interview questions.

Although there are some studies on the Fringe series (Daley, 2014; Sturgis, 2011; Wilcox, 2014; Yegen & Ulusoy, 2020; Zinder, 2014) in the literature, it is noteworthy that there are very limited studies that reveal the reflections of the series on the educational environment (Güven Yıldırım et al., 2022).

Teacher candidates were firstly asked to evaluate the character of Walter Bishop in terms of the characteristics that a scientist should have, in response to which teacher candidates evaluated the Bishop character in terms of the characteristics that a scientist should have around two themes, namely personal and professional characteristics. A review of the relevant literature showed that researchers working on scientists also examined the characteristics of scientists under two different categories, personal and professional characteristics (Güven Yıldırım, 2015). When teacher candidates talked about Bishop's personal characteristics, they said he was creative curious, ambitious, eager, open-minded, enthusiastic, free-spirited and crazy. They also said Bishop was someone who does research, questions, solves problems, observes, does not avoid discussions, cares about self-development, makes inferences and is open to learning, with respect to occupational characteristics. The codes that teacher candidates know about the personal and professional characteristics of Bishop's character are almost exactly the same as the characteristics that a scientist should have according to the literature. For example, Ayverdi (1969) defines scientists as curious, careful, productive, questioning, critical, skeptical, inquisitive, method-building persons who use current methods correctly. Also, a scientist has the right intuition, makes the right choices, produces solutions to problems, develops himself and uses information effectively, is focused, carefully examines his surroundings and has the capacity to put theoretical knowledge to use.

Afterwards, the teacher candidates were asked, 'When you watched the series as a science teacher candidate, did your views on physics, chemistry and biology applications/technologies change? Why?' While all of the teacher candidates responded to the question, they stated that their views had changed after watching the TV series and explained the positive and negative changes in their views, citing the reasons. The candidates stated the following as reasons for the positive change in their views: they understood the way scientists think and the nature of science, they learned new things about physics, chemistry and biology, they developed an objective point of view towards science and they realized the daily life applications of science, they realized that science pervaded every aspect of their lives, they learned about the relationship between different branches of science, they understood the power of science, they felt the desire to produce new ideas, projects, and do research and read. There are studies showing that works of science fiction cause changes of the kind mentioned in individuals. For example, a study conducted by Tatlı and Şahin (2020), studied the effect of science fiction movies on learning scientific concepts, and it concluded that science teacher candidates learned new scientific concepts at a sufficient level and updated/brushed upon their existing chunks of knowledge thanks to science fiction movies. Works of science fiction draw attention to the concepts in different fields of science (physics, chemistry, biology, etc.) and encourage students to learn scientific concepts (Shaw & Dybdahl, 2000), attract students' attention by visualizing scientific concepts, and enable scientific theories and theories to be questioned (Derjan Bayeh & Olivera Fuentes, 2011), helps students to distinguish between scientific and non-scientific knowledge by thinking critically, as it includes true (scientific) and false (fictional) information about science (Cornea et al., 2012), enables students to better grasp the basic concepts of many physics and chemistry subjects through building concrete, palpable images of scientific theories and certain scientific concepts in students' minds (Liberko, 2004). The study also found that the views of some teacher candidates had changed in a negative way. Teacher candidates who stated negative views changed said they had started to look with suspicion at some applications of science, understood how terrible biological and chemical weapons were, seen how people could abuse their power for greed and realized that ethical values could disappear quickly, and it was possible to use human subjects in experiments, and that science had no limits. There are studies reporting that the events, facts and patterns in some works of science fiction could cause such results. For example, according to Knippels, Severiens and Klop, (2009) science fiction movies raise awareness of socio-scientific issues and the scientific concepts within that scope by focusing on the relations between science and society. People can develop a future-oriented awareness by watching works of science fiction works and ask for pre-emptive measures to prevent potential issues in the future (İsmihan, 2005).

The study also asked teacher candidates their opinions on the impact of the actual use of technologies/applications shown in the series that are not available yet on society. Teacher candidates gave both negative and positive answers to the question of how the respective technologies/applications would impact society. Under the theme of positive effects on society, teachers' candidates stated that it would be very easy to go from one place to another with teleportation, that artificial organ production would save many people's lives, and switching between parallel universes would be a solution to the scarcity of resources and that many diseases would be treated very quickly with new generation smart drugs. Teacher candidates holding negative views stated that teleportation technology would bring chaos, biological/chemical weapons would bring the end of humanity, transition between universes would cause alien invasion and ethical values would disappear. Very similar to this conclusion, according to Yegen and Ulusoy (2020), the Fringe series reveals the effects of advanced scientific and technological developments on society, causes utopian and dystopian predictions to be questioned, and changes our perception of the universe and existence. At the same time, it tells us that what we should be afraid of is human nature, or human weaknesses and vulnerabilities, rather than advancements in science and technology and the new world it will create When the literature is examined, there are studies arguing that science fiction helps individuals make predictions about the future and develop their imaginative and creative skills. For example, according to Katz (1999), science fiction enables individuals to understand scientific concepts by using their imagination, making predictions, making scientific inquiries and establishing relationships between concepts. Ekem (1990) also states that science fiction movies deal with the future world, enable the putting forward of ideas about the future of technological products, handle the concepts of good and bad, and take advantage of the power of the big screen by appealing to the imagination of the individual. In this context, science fiction brings new dimensions of imagination to individuals, enabling them to steer and build upon their dreams.

Finally, teacher candidates were asked, 'If you had the power to use all the applications and technologies described in the series, which application/technology would you use and to what end?' When explaining which of the powers shown in the series they would use and to what ends, they mostly reported codes gathered under the theme of solving social problems. However, there are also many teacher candidates who would wish to use these powers to put an end to diseases. Teacher candidates also stated that they would benefit from these powers in order to turn themselves into a superior being. This result shows parallels with the scenario of the Fringe series on the human mind. Because in the Fringe series, the human mind is assumed to be important and functional enough to steer the universe (Yegen & Ulusoy, 2020). However, it is quite remarkable that all teacher candidates who watched the series stated that they would like to use the applications and technological powers shown in the series. A review of the relevant literature shows that there are studies arguing that movies affect individuals in particular. Studies state that movies have a hypnotic effect on individuals and people who watch them are influenced by them (Kamat, 2012); that watching movies creates strong experiences for people (Champoux, 1999); that movies have an impact on individuals' attitudes and behaviours (Birkök, 2008).

In the world we live in, knowledge, science and technology are developing at an unprecedented pace day by day, and this heavily affects the way we understand and make sense of the world (Yegen & Ulusoy, 2020). In this context, works of science fiction are very important in terms of enabling individuals to keep up with, predict and make sense of rapid developments in science. In the study, teachers had discussions on science and technology and the social effects of these technologies. Teacher candidates became aware of the positive and negative impacts of rapid advances in science and technology on society by watching the Fringe series. For future studies, other science fiction series and movies can be analysed in terms of events, phenomena and technologies to discuss their impacts on the society.

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