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SCIENCE AND NON-SCIENCE MAJORS' MENTAL MODELS OF NUCLEAR POWER: DOES THE PROGRAM OF STUDY MATTER?

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Abstract: The purpose of this study was to characterize science and non-science majors' mental models of nuclear power plants through their drawings. For this purpose, a total of 27 *Theology* and 26 *Science Education* college students were participated in the study. To collect data, students were first asked to state their decisions about the construction of nuclear power plant in the city they live, and then to think about nuclear power plants in their minds and draw the revived images on a paper. Data were analyzed through content analysis based on the SEE-STEP model. Findings revealed that religious beliefs and/or education may affect college students' reactions to nuclear power plants. That is, while most theology majors approached the construction of nuclear power plants positively, majority of science education majors did not. Theology majors referred mostly to economy in their drawings, while science education majors mostly to environment. Regardless of the program of study, on the other hand, the codes emerged from the drawings were mostly about environment, which was followed by technology, economics and science. Ethics was the least common subject area referred in the drawings of the students from both programs of study.

Key words: mental models, nuclear power, SEE-STEP model, socioscientific issues

1. Introduction

Religion and science are two ways of knowing, making the issues like happenings in the universe or the origin of living things a joint research. The relationship between these two, either seriously obstructing and destructing or compromising each other occasionally, has been the subject of various researches and discussions for centuries. After all, both are united in the common denominator of human. Many scientific issues, like cloning, stem cell studies, genome project and global warming, concern not only scientists but also all segments of society, including theologians. These issues, which are usually complex, open-ended and often creating dilemma in individuals with no definitive answers are called *socioscientific issues* [SSIs] (Sadler, 2004). While covering scientific data or claims on one hand, and including personal, social, political, religious or ethical dimensions on the other hand, cloning, stem cell studies, global warming, alternative energy sources, genetically modified organisms [GMOs], use of mobile phones, and nuclear power plants can be given as examples to SSIs (Yenilmez Türkoğlu and Öztürk, 2019). These issues require special attention and negotiation since they address a number of disciplines like biology [cloning and genetic engineering], chemistry [DDT and Dioxin], medicine [gene therapy and vaccination problem], physics [nuclear power] and environmental sciences [global warming], and they affect a wide range of concern from local to global (Chang Rundgren and Rundgren, 2010). Through SSIs, individuals need to pose various mental processes, such as critical thinking and decision-making (Chang Rundgren and Rundgren, 2010). Decisions are to be made at various levels from local to national (Driver, Leach, Millar and Scott, 1996) and they may differ. This situation brings mental models into forefront as effective elements in individuals' decisions.

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1. 1. Mental models

Mental models are spontaneous, naturally developed structures formed as a result of the interaction of people with their environment, with other people or with various works of technology; and they provide the necessary clues to understand this interaction (Norman, 1983). These models are internal knowledge representations about the world formed in the mind (Greca and Moreira, 2000). They are used to think, reason, and mentally represent the knowledge about the world (Brewer, 1987). They are dynamic; they evolve through individuals' perceptions and beliefs, social interactions, and experiences within their environment (Vosniadou, 1994). They are thought to be stored and retrieved from long-term memory or generated and expressed in response to a task (Vosniadou, 1994). Mental models can be expressed through actions, speech, or written explanations like writing or drawing (Gobert and Buckley, 2000). In other words, as used in this study, it is possible to uncover the models that people have in their minds through their drawings. That is, the identification of coherent patterns in participants' drawings is supposed to reveal the underlying mental models about the issue (Vosniadou, 1994). While revealing the models formed in the minds, it can be determined how and in what way the individuals conceptualize the issue (Vosniadou and Brewer, 1992). These models provide researchers with means to get access to the underlying knowledge and beliefs about the issue (Vosniadou, 2002). They also provide an efficient means of discovering the understandings and misunderstandings (Sibley, 2005). Through examining individuals' mental models, researchers can understand the effects of cognitive, social, and contextual factors on the conception development about the issue (Vosniadou, Ionnides, Dimitrakopouou, and Papademetrios, 2001).

Since individuals have differing educational, cultural/social, and personal backgrounds, they have differing mental models (Glynn and Duit, 1995). In other words, formal education that individuals take in their lives is among the important factors in the formation of mental models. In this study, theology and science education majors' mental models of nuclear power plant was examined. By this way, it is hoped to see the similarities and differences among mental models of theology and science education students who are studying in different programs but are in a position to decide about SSIs and even direct the society. Examining theology majors' and science education majors' mental models may also help us infer about the factors associated with the educational practices that college students take. Based on the findings, educational practices that form, facilitate or constrain mental models about nuclear power plants can be identified, and teaching and curricular implementations can be organized to develop a better understanding of the domain knowledge about nuclear power plants. Students' mental models can also assist teachers to foster students' limiting mental models and encourage the development of scientific mental models.

For the purpose of examining college students' mental models, SEE-STEP model that covers the subject areas of sociology/culture [S], environment [E], economy [E], science [S], technology [T], ethics/morality [E] and policy [P] (Chang Rundgren and Rundgren, 2010; Eş and Öztürk, 2021) was used in this study.

1. 2. The SEE-STEP model

To provide a holistic view of SSIs, Chang Rundgren and Rundgren (2010) presented the SEE-SEP model. Thereafter, the model was revised by Eş and Öztürk (2021) and Technology subject area was removed from the Science subject area and added as an independent one, forming the SEE-STEP model (See Figure 1).

The details of the subject areas of the model are as follows:

1.2.1. Sociology/Culture (S). It is undeniable that human reasoning or argumentation processes are affected by social or cultural backgrounds. For example, while mobile phone communication is an indispensable element of our lives, people living in Amazon rain forest may think that it is a useless invention because the necessary network has not yet been established or the people in there do not need it yet (Chang Rundgren, 2011).

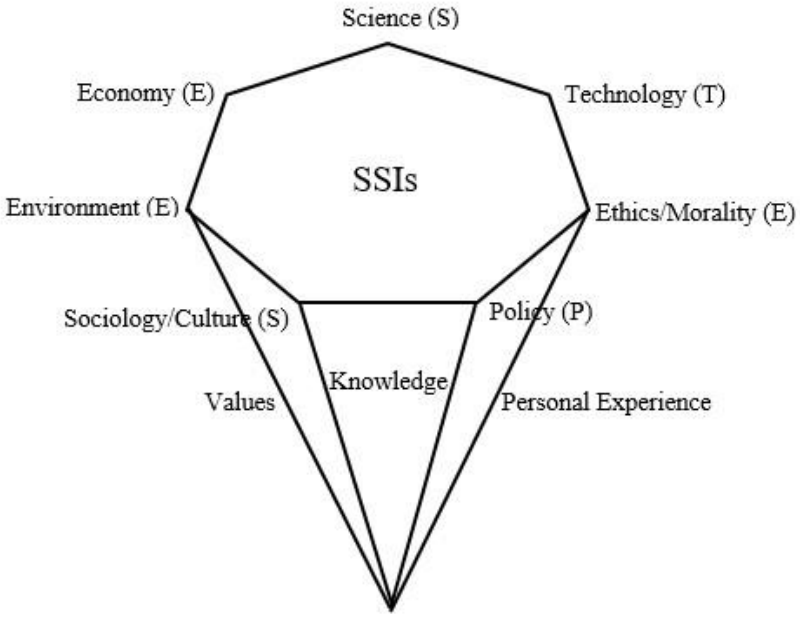

Figure 1. *SEE-STEP Model* (Eş and Özturk, 2021)

1.2.2. Environment (E). Today, more and more SSIs, such as car use, nuclear energy, global warming and GMOs stand out with their direct interest in environmental and ecological areas (Chang Rundgren and Rundgren, 2010), enabling *environment* be considered as a separate subject area detached from the subject of science.

1.2.3. Economy (E). One of the important aspects that stand out in discussing SSIs and affecting decisions of individuals is economy. For example, using DDT to kill mosquitoes and eliminate malaria in a poor country is acceptable for some individuals since the weak economy of the country may cause them to consider protecting people from current disease as a priority by ignoring possible future harms of DDT (Chang Rundgren and Rundgren, 2010).

1.2.4. Science (S). Providing students with opportunities to apply scientific knowledge in their daily lives is among the basic goals of a science educator. SSIs act as real contexts for students to practice what they have learned. For this reason, scientific information on different subject areas [i.e., biology, chemistry, technology and medicine] should be included in the thinking processes of individuals (Chang Rundgren and Rundgren, 2010).

1.2.5. Technology (T). In the model they developed [that is, SEE-SEP], Chang Rundgren and Rundgren (2010) considered technology as a branch of science. However, although they are in close interaction, technology and science are different fields. At this point, the SEE-SEP model developed by Chang Rundgren and Rundgren (2010) was revised and used as SEE-STEP model by adding technology as a separate subject area (Eş and Öztürk, 2021. Technology is expressed as both a type of information that uses concepts and skills from other disciplines [i.e., science, mathematics and culture] and as the provision of this information to human service to meet a specific need or solve a specific problem using materials, energy and tools (MoNE, 2006).

1.2.6. Ethics/Morality (E). When dealing with SSIs, ethical and moral concerns are discussed and emphasized. It is important to address animal and human rights within this subject area (Chang Rundgren, 2011).

1.2.7. Policy (P). Some people may opt to make their SSI-related decisions according to the government policy or laws. In other words, they may have more confidence and reliance on their government or authority than others. For example, people may support the construction of a new nuclear power plant just because they trust their government's succession (Chang Rundgren and Rundgren, 2010).

1. 3. The purpose of the study

As mentioned previously, the present study aimed to examine theology and science education majors' mental models of nuclear power plants. The research question of the study is defined as follows:

What are the characteristics of theology majors' and science education majors' mental models of nuclear power plants?

2. Methods

2. 1. Participants

A total of 27 *Theology* and 26 *Science Education* college students were participated in the study. All students were seniors – that is, they were in the final semester of their four-year undergraduate education program. During their typical four years of course work, Theology majors are required to take Islamic religion courses, educational sciences courses and some other courses like Psychology of Religion, Sociology of Religion, History of Philosophy, History of Religions and Philosophy of Religion. Graduates of this program are supposed to work as Religious Culture and Moral Education Teachers at primary or secondary schools, as Vocational Course Teachers at Imam Hatip High Schools (a religious education school), or as mufti, assistant mufti, preacher, imam or muezzin at central, provincial or overseas organizations of Religious Affairs Directorate. They can carry out religious services or consultancy in various institutions and organizations as theologians.

Science education majors, on the other hand, are also educated through a four-year undergraduate program and are to complete several courses in science (i.e., biology, chemistry and physics) and nature of science (NOS), as well as courses related to the teaching profession. Graduates of the program are prepared as science teachers, who are responsible for teaching all science subject areas in Grades 5–8. They have job opportunities in public or private secondary schools.

2. 2. The SSI context used in this study: Nuclear power plants

Sinop, the city where the current research was carried out, is a settlement that stands at the far north of Turkey with its historical and natural beauties. The city is a natural harbor surrounded by the Black Sea on three sides. Government intends to build the second nuclear power plant in Sinop (first is under construction in Mersin) to meet the increasing energy demand. The construction of the power plant, however, is a controversial topic in Turkey, as well as in Sinop. A variety of supporting or opposing statements from scientific communities, scholars, decision makers, non-governmental organizations (NGOs) and media are on the agenda of the society. Supporters claim that nuclear energy will decrease Turkey's energy dependency on other countries, while opponents argue that it creates serious risks to the environment which in turn may affect human health and lives (Akyüz, 2017). The issue has long been on the agenda of the residents of the city as well; and this is the most important reason of conducting the current research in this context. The participants of the present study were not introduced by the issue as a part of the research, yet they were living the issue as being the residents of the city.

2. 3. Data collection and analyses

The survey method was used in this study. To collect data, students were first asked to state their decision about the construction of the nuclear power plant in Sinop. Then, they were asked to think about the nuclear power plant in their minds and draw the revived images in their minds on the paper given to them. Students were also requested to provide further explanations on their drawings when needed (i.e., in case of bad drawing or being unable to draw). They were not asked to provide any information about themselves in order to make them feel free and comfortable. Students were given a course hour (45 min.) but it took approximately 30-35 minutes to complete their drawings. Students' drawings provided an efficient means of discovering their mental models. They provided visual representations that carry a lot of information. Although expressing the concepts as prototypes and shortly written descriptions or explanations seem to be limited in conveying what was in the mind of

the student, common representations drawn by many students provided strong evidence of a widespread understanding.

For the analyses of the data, first, papers were numbered including the department of the students (that is, T1, T2, T3, … for theology students, and S1, S2, S3, … for science education students). Later, each paper was analyzed through content analysis; revealing the first list of codes and identifying the themes emerging from the codes (Bogdan and Biklen, 2007). Two researchers independently coded the data and they reviewed and discussed the codes until they come up with a final list. With this final list of codes, drawings were examined for reconsideration and once the codes were found to fully reflect the drawings, the relevant frequencies were determined. The analysis process ended by the final list of codes classified under certain categories (Creswell, 2005). These categories are comprised of the subject areas in the SEE-STEP model described in the introduction part.

3. Findings

In this study, students were asked to express their decisions regarding the construction of a nuclear power plant and to illustrate their feelings and thoughts (mental models) through drawings. Findings regarding participants' decisions about the construction of nuclear power plant are presented in Table 1.

Table 1. *Participants' decisions about the construction of nuclear power plant*

	Theology		**Science Education**	
Decision:	n	%	n	%
should be built	21	77.8	7	26.9
should not be built	6	22.2	19	73.1

As Table 1 shows, the program that participants studying may be influential on their decisions about the construction of the nuclear power plant. Six theology majors out of twenty-seven (n=6, 22.2%) endorsed the construction of a nuclear power plant, whereas twenty-one of them (n=21, 77.8%) did not. Nineteen science education majors out of twenty-six (n=19, 73.1%), on the other hand, disaffirmed the construction of a nuclear power plant, while seven (n=7, 26.9%) affirmed.

Following their approaches to the construction of a nuclear power plant, students' mental models were analyzed with respect to the subject areas (that is, the SEE-STEP model). Findings are given in Table 2 and Figure 2.

Table 2. *Participants' decisions about the construction of nuclear power plant*

	Theology		**Science Education**		**Total**	
Subject Areas:	f	%	f	%	f	%
Sociology/Culture	6	9.52	2	2.63	8	5.75
Environment	12	19.05	29	38.16	41	29.50
Economy	19	30.16	5	6.58	24	17.27
Science	6	9.52	17	22.37	23	16.55
Technology	16	25.40	20	26.32	36	25.90
Ethics/Morality	1	1.59	1	1.32	2	1.44
Policy	3	4.76	2	2.63	5	3.60

As Table 2 shows, regardless of the program of study, the codes emerged from the drawings were mostly about environment (f=41, %=29.5), which was followed by technology (f=36, %=25.9), economics (f=24, %=17,27), science (f=23, %=16.55), sociology (f=8, %=5.75), policy (f=5, %=3.6) and at least by ethics (f=2, 1.44%).

In regard of the program of study, however, theology majors referred mostly to the economy (f=19; 30.16%) in their drawings, while science education majors mostly to the environment (f=29; 38.16%).

Policy has a ratio of 4.76% in the drawings of theology majors and 2.63% in the drawings of science education majors (See Table 2 and Figure 2).

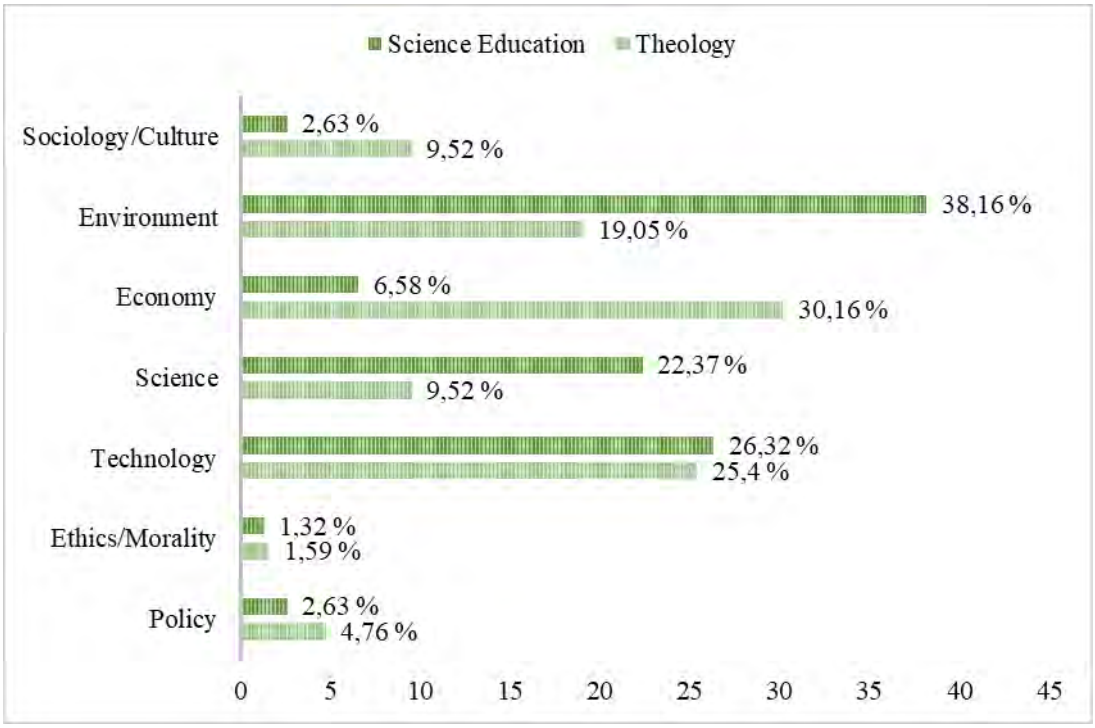

Figure 2. *Distribution of codes with respect to the subject areas and program of study*

Codes regarding *sociology/culture* are given in Table 3. As Table 3 shows, theology majors referred to this subject area more than science education majors did, and all codes they presented were positive, like happy people. As can be seen in the sample drawings of T30 and T31 (see Figure 3), theology majors who presented elements related to sociology/culture in their drawings stated that the construction of a nuclear power plant will have a positive effect on the social life. While sociology/culture is in fourth place together with science in the drawings of theology majors, it is in the fifth place with a low frequency (f=2) in the drawings of science education majors. The two science education majors here presented that the construction of a nuclear power plant would bring chaos to the country.

Table 3. *Codes regarding sociology/culture subject area*

	Theology		Science Education	
Code:	**Agreed**	**Disagreed**	**Agreed**	**Disagreed**
Happy boy flying a kite	1	-	-	-
A man making barbecue	1	-	-	-
Happy family/people	4	-	-	-
Chaos	-	-	-	2
Total	6			2

In contrast to sociology/culture subject area, codes regarding *environment* came mostly from science education majors and were mostly negative (f=27). Science education majors highlighted the environmental damage in biosphere, hydrosphere and atmosphere by drawing images like dead organisms, health problems, explosion, polluted environment and toxic gases (see Table 4). As seen in the drawing of S24 (see Figure 3), for example, the mostly cited element was toxic gases (f=5). Theology majors, on the other hand, considered the construction of a nuclear power plant more environmentally friendly than science education majors. The frequencies of the positive and negative items related to the environment subject area of theology majors (that is, f=6 for each) were equal (see Table 4).

Table 4. *Codes regarding environment subject area*

Category	Code	Theology		Science Education	
		Agreed	Disagreed	Agreed	Disagreed
Biosphere	Flower	2	-	-	-
	Dead flower	-	1	-	-
	Tree	1	-	-	-
	Fallen tree	-	1	-	2
	Dead animal	-	1	-	2
	Dead people	-	-	-	3
	Unhealthy people	-	-	-	2
	Masked people (for safety)	-		-	3
Atmosphere	Sun-smiley	2	-	-	-
	Cloud	1	-	-	-
	Explosion	-	1	-	2
	Toxic gases	-	1	1	3
	Acid rains	-	-	-	1
Hydrosphere	Dead fish	-	1	-	3
	Waste water	-	-	-	3
	Uninhabitable/polluted sea	-	-	-	3
	Inhabitable sea	-	-	1	-
Total		6	6	2	27

Codes regarding *economy* belonged mostly to the theology majors (see Table 5). They brought the currency symbol (f=7) to the forefront as seen in the drawing of T14 (see Figure 3), indicating that nuclear power plants would bring significant economic power to the country. Theology students also included workers (f=3) who work happily in the economy, in their drawings. It is also important to note that while economy subject area took the first place in the drawings of theology majors, science education majors ranked it as fourth among the seven subject areas.

Table 5. *Codes regarding economy subject area*

Code	Theology		Science Education	
	Agreed	Disagreed	Agreed	Disagreed
Housing for employees	-	-	-	1
Buildings	3	-	-	1
Currency symbol	7	-	1	2
Employees	3	-	-	-
Rich man	1	-	-	-
Barbell	1	-	-	-
Bone and skull	1	-	-	-
Flag	2	-	-	-
Muscle	1	-	-	-
Total	19		1	4

Codes regarding *science* came mostly from science education majors. That is, items belonging to science subject area took the third place, constituting 22.37% of the drawings made by science education majors. As seen in the sample drawing of S14 (see Figure 3), science education majors included mutational elements in their drawings the most, while theology majors referred to energy. Items in science subject area are in the fourth place in the drawings of theology majors with a rate of 9.52%. Unlike science education majors, theology majors did not mention mutation but instead they included items related to electricity in their drawings.

Table 6. *Codes regarding science subject area*

Code	Theology		Science Education	
	Agreed	**Disagreed**	**Agreed**	**Disagreed**
Mutated human	-	-	-	5
Mutated animal	-	-	-	3
Radiation warning symbol	1	-	1	3
Energy sign	2	-	-	-
Electric wires and pylons	2	-	2	-
Atomic model	1	-	-	-
Total	6		3	11

Regarding the *technology* subject area, drawings of a cooling tower was very common both among theology and science education majors. The interesting point was that, cooling towers took place in the drawings of theology majors who *supported* the construction of a nuclear power plant, while they took place in the drawings of science education majors who *did not support* it. Moreover, this item (that is, the cooling tower) appeared to be the most common element among the drawings of both theology (f=15) and science education (f=20) majors in the present study (see drawings of S14, S24, T30 and T31 in Figure 3). Drawing of a cooling tower also enabled the technology subject area to take the second place among the seven subject areas for both theology and science education majors.

Table 7. *Codes regarding technology subject area*

Code	Theology		Science Education	
	Agreed	**Disagreed**	**Agreed**	**Disagreed**
Technical drawing	1	-	-	-
Cooling tower	11	4	5	15
Total	12	4	5	15

Ethics/morality was the least common subject area that the students in both programs of study placed in their drawings. One student from each program included items from this subject area, and both depicted angry animals by drawing attention to animal rights.

Table 8. *Codes regarding ethics subject area*

Code	Theology		Science Education	
	Agreed	**Disagreed**	**Agreed**	**Disagreed**
Angry animal (animal rights)	-	1	-	1
Total		1		1

Policy has a ratio of 4.76% in the drawings of theology students and a ratio of 2.63% in the drawings of science education students. It was seen that these students approached positively to the construction of a nuclear power plant and used slogans to state their support, as can be seen in Table 9 and in the drawing of T30 (see Figure 3).

Table 9. *Codes regarding policy subject area*

Category	Code	Theology		Science Education	
		Agreed	**Disagreed**	**Agreed**	**Disagreed**
Slogan	If the president wants to build, no trouble.	1	-	-	-
	We want the nuclear power plant.	1	-	-	-
	Strong and independent country.	1	-	-	-
	Yes to nuclear power plant.	-	-	2	-
Total		3		2	

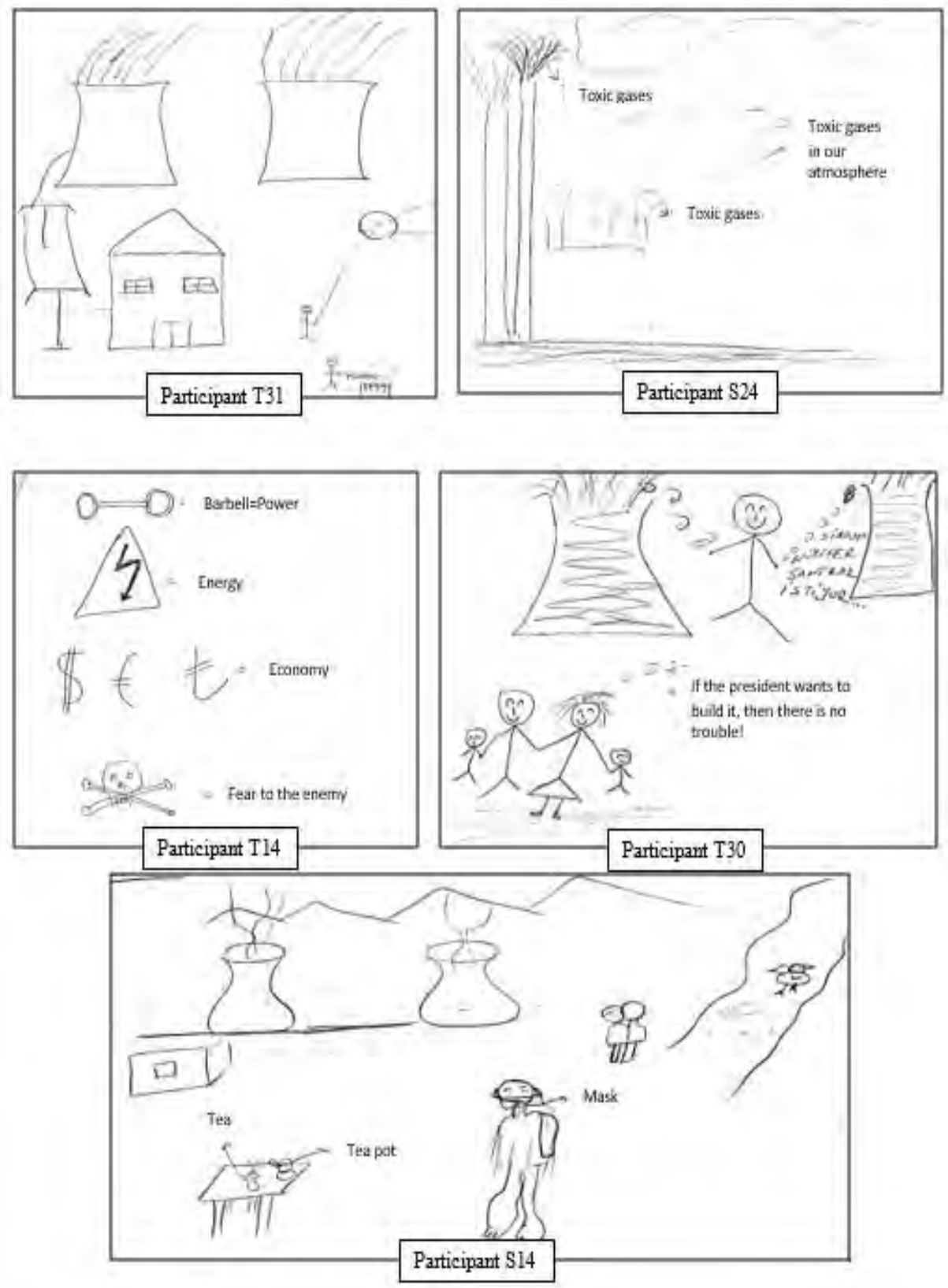

Figure 3: *Sample drawings of participants*

4. Discussion and conclusion

The purpose of this study was to characterize theology majors' and science education majors' mental models of nuclear power plants through their drawings. In the related literature, there are studies investigating students' decisions regarding SSIs but participants were mostly prospective teachers in these studies (i.e., Eş, Işık Mercan and Ayas, 2016). Moreover, most studies about science and religion in the science education literature are restrained to issues concerned with Christian religions; and little is known about non-Christian educational contexts (Coll, Taylor and Lay, 2009). The largest portion of the Turkish population (that is, 98%) is Muslims (Grim and Karim, 2011). The current study, at this point, was thought to be valuable in that it covers participants from two differing programs in a state university in Turkey, -that is theology and science education programs-. Turkey is a democratic country where religious and governmental affairs function independently. Religious education is given at primary and secondary schools as a course and students learn positive sciences without the influence of religion. It is undeniable that religious beliefs and scientific thinking are personal, and the mental construction of beliefs is also a personal cognitive process. However, it is observed in this study that religious beliefs and/or education may affect college students' reactions to nuclear power plants. Most theology majors (77.8%) approached the construction of nuclear power plants positively and emphasized their contribution to the economy of the country, while majority of science education majors (73.1%) did not. According to us, the rationale for this finding may be participants' adoption of a religious perspective in their evaluations of nuclear power plants. Researchers argue that there is a contrast between religious habits of mind and scientific habits of mind, and due to the difference in their nature, science education and religious education are in conflict with each other (Good, 2001). According to Good (2001, p.4), "the habits of mind associated with most religious beliefs include faith in the authority of holy books and religious leaders". This means that religious habits of mind do not usually look for evidence in assessing ideas or making decisions. Even some researchers argue that religion is anti-science (see Matthews, 1996). However, we believe that Good's (2001) suggestion of the use of historical examples that include the conflict between science and religion (like the role of Church in science during the Middle Ages) in educational contexts may be helpful.

Related literature together with the findings of this study suggest that individuals bring in their own values, worldviews, and feelings implicitly or explicitly as they talk about SSIs; and their reactions are influenced by their backgrounds such as religion, family background, personality, past experiences, personal interests, and prior knowledge (Chang and Lee, 2010). In other words, beliefs, values, and religious perspectives came into play in making decisions about SSIs. In their study, Sadler and Donnelly (2006) investigated how content knowledge and morality contributed high school students' quality of SSI argumentation, and they found that one-half of the participants cited personal religious beliefs as significant factors contributing to their negotiation of the scenarios or the opinions of others. In addition, it was observed that although students had access to same information, they made their decisions by interpreting this information differently from each other (Rundgren, Eriksson and Chang Rundgren, 2016). It is stated that these differing interpretations may result from the differences in individuals' beliefs (Kolstø, 2006) and their intellectual knowledge (Zeidler, 1997). Differing interpretations may be a result of differing beliefs, values and knowledge, but together with that, they can be regarded as normal when we consider the controversial nature of SSIs which have no definitive answer, as well.

Findings of this study showed that majority of science education majors (73.1%) did not support the construction of nuclear power plants. Science education majors' negative decisions on the construction of nuclear power plants was reported previously in the related literature. In a similar study conducted by Yenilmez Türkoğlu and Öztürk (2019), science education majors depicted mostly dead sea organisms, disabled individuals and leafless trees in their drawings, and they rarely depicted electricity generation, population and opportunity growth and economic power. Similarly, in another study, Ateş and Saraçoğlu (2013) stated that the science education majors in their study held negative opinions towards nuclear power plants and described them as emitting harmful substances to the environment, as releasing nuclear waste that may seep down to the groundwater and radioactive wastes that may pose danger to living organisms like causing cancer among babies and children. Together with such negative opinions, however, positive backings are also stated in the same study, -although being

relatively rare. The participants in that study thought that nuclear power plants would reduce the dependency of the country to other countries and meet the energy need.

Regarding the subject areas offered by the SEE-STEP model, the findings of the present study showed that theology majors mostly referred to economy (30.46%), technology (25.4%) and environment (19.05%), while environment was the highest (38.16%) in science education majors' drawings followed by technology (26.32%) and science (22.37%). Theology majors having elements mostly about economy and science education majors about environment indicates that the education that students take may affect their mental models on scientific or technological issues that concern the society. Similarly, while science subject area was ranked in the third place in science education majors' drawings, it was in the fourth place together with sociology/culture subject area in the drawings of theology majors. This result may also be associated with the education they received. Science education majors are taking courses related to physics, chemistry, biology, etc., while theology majors are not. This finding also shows that theology majors' mental models of nuclear power plants consist of science subject area at an equal level with sociology/culture subject area.

Drawings about technology were ranked as second by both majors. Interestingly, however, it was seen that all the drawings except one in this subject area indicated a cooling tower. This can be explained by 'the cooling tower as being the most prominent image about nuclear power plants' that take part in the sources like media, internet, posters, brochures, books, etc. This situation is a state of cultivation other than planned educational activities. As a matter of fact, as stated by Türkmen, Pekmez and Sağlam (2017), science education majors acquired information about SSIs mostly from their social environment, that is, from social and visual media, and their friends and families. Another point to note about the cooling towers was that, some students in the present study (4 theology, 1 science education) defined the gas released to the atmosphere from the cooling towers as toxic gases, although it is actually water vapor. This finding indicated some possible misunderstandings regarding nuclear power plants, which obviously needs further research.

In the drawings, ethics/morality was the least common subject area that both theology and science education majors referred. This finding is similar to the findings in the related literature (Christenson, Rundgren and Höglund, 2012), although the ethical dimension of SSIs is quite important and is seriously emphasized (Zeidler and Keefer, 2003). At this point, it is valuable to use the SEE-STEP model as an important tool for individuals to realize the subject areas that they are not using or are aware of, and to encourage them to deal with the issue from different dimensions.

In this study, the value of students' drawings as a means of discovering their mental models about nuclear power plants was apparently seen. Students come to classrooms with differing cultural, educational, and personal experiences, and therefore they each have different mental models (Glynn and Duit, 1995). However, the findings of this study together with similar others show that drawings representing students' mental models can be interpreted. Findings obtained through drawings in this study showed that college students' religious beliefs and/or the education that students take seem to be influential on their mental models. More research at this point is obviously needed to understand the reasons behind socioscientific decisions. Theologians and teachers are two groups of people who shape our knowledge, beliefs and decisions. Graduates of these two programs are in a position to decide about SSIs and even direct the society. The fact that at least some of them appeared to hold misunderstandings about nuclear power plants indicates that such understandings together with their sources and possible solutions for eliminating them requires further research, as well.

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