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INVESTIGATING OF THE RELATIONSHIP BETWEEN THE VIEWS OF THE PROSPECTIVE SCIENCE TEACHERS ON THE NATURE OF SCIENTIFIC MODELS AND THEIR ACHIEVEMENT ON THE TOPIC OF ATOM

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Abstract:
A non-experimental descriptive and correlational design was used to examine the 'notion of the nature of scientific model, atom achievement and correlation between the two' held by a total sample of 76 prospective science teachers. "Students' Understanding of Models in Science" scale was utilized to evaluate the views of the prospective science teachers on the nature of scientific models. "Atom Achievement Test" was used to determine the achievement levels of the prospective science teachers. Some meaningful outcomes were obtained related to the views of the prospective science teachers on the nature of scientific models. No any significant relationship was observed between the views of the prospective science teachers on the nature of scientific models and their achievement in the topic of Atom. The findings have been analysed by comparing them with the relevant literature and the implications to enhance prospective science teachers modeling ability have been discussed.

Keywords: chemistry education, nature of scientific models, the atom topic, prospective science teachers

1. Introduction

Metaphors, analogies, and models are part and parcel of the language of science that is used on a daily basis (Harrison & Treagust, 2000). We discover that metaphors, analogies, models and images are helpful for students to make proper sense of abstract and difficult concepts. Significantly, it is possible to make a large number to establish and examine the construction of the students' knowledge. Ontologically knowledge has to do with an individual experience on a personal level (Taber, 2014, p.7).

Models are the main product of science as well the most essential elements of scientific method (Adadan, 2014; Gilbert & Boulter, 1998). Scientific models are always the only way to explain an abstract scientific theory. Scientists' agreement models are given as fact, as the consequence, that it is an acceptable model of a scientific theory; for instance, the model of the atom (Treagust, Chittleborough, & Mamialo, 2002). Models are the principal tools of learning in science education. It is rare that a science lesson passes without the manifestation of not less than one or more analogical models to give explanation of some aspects of the content of the science. Teachers use models to explain the most complicated and abstract science concepts and make it more understandable for their students (Harrison & Treagust, 2000). But analogical models are above tools of communication: they make provision for searching, analysing, and examining scientific and mathematical concepts; and they assist in making science important and absorbing (Hodgson, 1995). As highlighted by Pintrich, Marx, and Boyle, (1993) interest is just as relevant as content knowledge because learners will not involve in scientific concepts except they realize they are interesting, important, and worth giving attention to.

2. Literature Review

2.1 Models and Modelling About the Atom and Atomic Theories in Chemistry Education

Because chemistry has to do with atoms, molecules and ions that are unthinkably minute, changes at the particle level could only be explained by the theories that makes use of a plethora of models. Comprehensively, atomic theory is established above any other topic in chemistry on a different model that gives explanation of a specific behavior. Therefore, chemists are crucially modellers of the substances that establish such materials and of their metamorphosis. By following this pattern, they try to predict the crucial situations both for the appearance of interesting transformations and to be able to avoid the uninteresting aspects (Justi & Gilbert, 2002; Harrison & Treagust, 1996).

Chemical phenomena are considered by the chemists in three stages of representation –macroscopic, symbolic and submicroscopic – that are directly in contact with each other (Johnstone 1982). The macroscopic stage is the observable chemical phenomena and can involve the experiences of the learners ′ day-today lives, like the changes of colour, observation of the new products being created and others vanishing. For the purpose of talking about these macroscopic phenomena, chemists commonly make use of the symbolic level of representation that has the inclusion of pictorial, algebraic, physical and computational forms such as chemical equations, graphs, reaction mechanisms, analogies and model kits. As highlighted by some researchers (Luisi & Thomas, 1990, p. 67; Suckling et al., 1980, p. 26) modelling becomes popular in chemistry. It has become "the dominant way of thinking" as the subject has gone to a great stage of maturity, what the chemists do "*without having to analyse or even be aware of the mechanism of the process*" (Cited in Justi & Gilbert, 2002). This is because of the explanations of the natures of substances and of their transformations which are importantly abstract.

Thomasi (1988) and Nersessian, (1999), state that thinking with models allows chemists to have a proper visualization of the entities or the processes, plan experimental activities and give backing to the processes of reasoning and constructing knowledge (Cited in Justi & Gilbert, 2002). Furthermore, chemists have been able to transforms models in one mode of representation into the same representation in different forms (Kozma & Russel, 1997). Most scientific ideas rely on multiple models for their description and explanation (e.g., electricity, genes, atoms, and plate tectonics). Great abstract and non-observable phenomena are analysed through the use of multiple models (e.g., atoms, molecules, and bonds). The reason for this is that every model increases, but a fraction of the target's attributes. For most ideas, the sum of the ideas's models is lower than the whole phenomenon because of two reasons: the concept itself is totally not comprehensive, and the models overlap to some certain degree. For epistemological purposes, there has not been a single model that can fully explain an object or process. If that is done, it would be refered to as an example not a model; and if the concept was understood well, there would be less need for analogical models (Harrison & Treagust, 2000). Such models may be established on various qualities of representation (Boulter & Buckley, 2000). Thus, chemical knowledge about a range of phenomena is produced and communicated by using several models that develop and are transformed as the advances of the field of enquiry.

While introducing the non-observable entities like atoms and molecules to the learners, teachers and textbook writers are compelled to introduce analogies, analogical models, and representational models like chemical formulas and chemical equations.

Many learners find analogical models in scientific explanations difficult and confusing. Learners usually do not progress beyond a model's surface.Therefore this challenge is very serious for young learners and those whose abstract reasoning is not strong (Garnett & Treagust, 1992; Harrison & Treagust, 1996; Harrison & Treagust, 2000).

Grosslight and colleagues (1991) examined the beliefs of the learners about the structure and efficacy of analogical models. They consider many lower secondary learners as level 1 modelers, because these learners believe that there is a 1: 1 correspondence between models and reality (models are toys or little copies of actual objects that are not complete); models is expected to be "right"; items become missing in the sense that the modeler allowed the model that way, and they do not seek ideas or purposes in the model's form. Some secondary students are able to reach level 2, where models especially remain real-world objects or occasions instead of representations of concepts; they are not complete or have any disparity relying on the context; and the importance of the model is to communicate instead of exploring the concepts. Experts alone give satisfaction to level 3 requirements that models are supposed to be multiple; they are the tools for thinking; and the modeler can deliberately manipulate them to be suitable for his/her epistemological needs.

Notwithstanding, in a wide investigation of the understanding of the teacher and the use of models and modelling by Justi and Gilbert (2003), in their attempt to establish a 'profile of understanding' for every teacher, it became impossible to give definition about patterns that corresponded to Grosslight et al.'s (1991) levels. Looking at it from other angle, they postulated that only teachers who have a degree in chemistry or physics were able to make a discussion on the notion of model that was properly close to the accepted scientific ideas. Their study did not support the notion of a 'hierarchy of levels' in the understanding of the teachers 'notion of the 'model'.

In the light of the related premise studies, to investigate the prospective science teachers' notions on the scientific models is important since models are the principal tools of teaching and learning in science education. Furthermore, the prospective science teachers as future science teachers will be teaching science topics between 5th and 8th grades in elementary school.

3. Purpose, Material and Methods

The focus of this research is to investigate the views of the prospective science teachers on the scientific models and whether is there any correlation between their achievements in the topic of atom and their notions on the scientific models. For this aim, answers to the following research questions were sought:

1. What are the views of the prospective science teachers on the scientific models?
2. Is there a significant relationship between the views of the prospective science teachers on the scientific models and their achievements in the topic of Atom

This study is a non-experimental simple descriptive and correlational design (Büyüköztürk et al., 2008, s.15).

3.1 Educational Background and Sample

The sample of the study comprises 76 first grade prospective science teachers (major science students) on-going faculty of education at a state university located in Konya (Mid-anatolia region), Turkey. The duration of the Science Teacher Programme is 4 years and every academic year has two consecutive semesters as fall and spring. The researchers collected the data during the 2014-2015 academic year, at the end of the spring semester. The participants took General Chemistry I and General Pyshics I courses in the fall semester, and General Chemistry II, General Physics II and lab courses in the spring semester. Atomic structure and related theories also have a crucial position in the General Chemistry I courses at the Science Teacher Programme of education faculties in Turkey (Yıldız, 2002; Nakipoğlu, 2008). And also the atomic models are integral part of the Turkish high school chemistry curriculum. In the 9th grade, students having learned about Dalton's theory, Rutherford's model of atom, and Bohr' atomic theory, are introduced with the quantum mechanical theory. Learners in their high school meet the orbital idea in chemistry subject for the first time. Teachers teach them first quantum number and orbital types (s, p, d, f), and explain only the shapes of s and p orbital types.

The learners had never received any specific teaching about scientific models in science; therefore, the responses reveal their understanding on the basis of the experience they had in general science curriculum. All participants were informed about the nature and methods of the study. They all agreed to participate in the study on a voluntary basis.

3.2 Data Collection

A 30- item scale rated on a 5- point Likert type and entitled "Students' Understanding of Models in Science" (SUMS) was used to assess the views of the prospective science teachers on the scientific models. This scale "Students' Understanding of Models in Science (SUMS)" was developed by Treagust et al. (2002) and later translated into

Turkish by Güneş, Gülçiçek and Bağcı (2004). The original scale had 27 items. Yet Günes et al. (2004) added 4 items to the 26 items of the original scale. The participants were asked to rate their own opinions on the following range: "I never agree (N), I partially disagree (P), I have no idea/I am not sure (S), I agree (A), I totally agree (T).

Treagust et al. (2002) determined 5 sub-dimensions in the 27-item SUMS scale using the confirmatory factor analysis. Each dimension comprises a theme related to the characteristics of the scientific models. For example: (1) Scientific models as multiple representations (MR), (2) Scientific models as exact replicas (ER), (3) Models as explanatory tools (ET) (4) The uses of scientific models (USM) (5) The changing nature of models (CNM). The scale was added a new dimension called Model Examples (ME) by Günes et al. (2004). Treagust et al. (2002) indicated that the Cronbach Alpha reliability coefficient of the sub-dimensions of the SUMS scale range between 0.71 and 0.84. The Cronbach Alpha reliability score of the total scale used in the present study was found as 0.741 which is quite consistent with the above mentioned scores. Since the satisfactory reliability level is 0.70 and above (Nunnally, 1978) it can be said that the scale used in this study is quite reliable.

A Multiple choice "achievement" test was utilized to assess the achievements of the prospective science teachers in the topic of "atom." The achievement test, which comprises 34 multiple choice questions, was piloted with 117 prospective science teachers, who are not the participants of this study. The Cronbach Alpha reliability score of the obtained data was found as 0.752. This score is an acceptable range. Yet, because the test includes too many questions and in order to increase the reliability of the achievement test, the correlation between the questions (Corrected Item-Total Correlation) was measured. The questions scored below 0.30 (7, 10, 12, 13, 14, 15, 23, 24, 25, 27, 30, 34) were eliminated from the achievement test and the Cronbach's Alpha was recalculated and found as 0.806. In this study, the Atom Achievement Test-AAT, which includes 22 questions with high reliability score, was used. The content of the test questions and the presentation form of these questions are shown in Table 1:

Table 1: The Content of the Questions in Atom Success Test and Their Presentation Form

The content of the question	Question number	Presentation Form
Atomic Structure	7,11,12,13,19	Verbal
Atomic Models and their historical evolution	4,9	Visual + verbal
	5,6,20,21,22	Verbal
The characteristics of Atom	1,2,3,8,10,14,15,16,17,18	Verbal

3.3 Data Analysis

Each item in the SUMS scale scored in the range of (1) I never agree, (2) I partially disagree, (3) I have no idea/I am not sure, (4) I agree, (5) I totally agree, and a descriptive analysis was performed .

The correct answers of the participants to the Atom Achievement Test were coded as 1, and the wrong answers were coded as 0 in the data set. Descriptive analysis was performed after the total scores of each student obtained from the Atom Achievement Test were calculated.

In order to determine the correlation between the views of the participants on the scientific models and their achievement rates in the topic of atom, the total scores the participants gain from the AAT and the total scores they obtained from the SUMS scale, and the subdimensions of the SUMS scale (Scientific models as multiple representations -MR, Scientific models as exact replicas- ER, Models as explanatory tools- ET, The uses of scientific models -USM, The changing nature of models- CNM, Model Examples-ME) were analysed using by Pearson Correlation.

4. Results and Discussion

4.1 Descriptive Analysis Results

The obtained data from the SUMS Scale were analysed using SPSS 16 program. The results of the Descriptive statistics were presented in Table 2.

Table 2. Descriptive Results of Prospective Science Teachers Related to SUMS Scale (N=76)

Factor/Item Number	Item	Mean (sd)	% Agree*	% Not Sure	% Disagree**
MR/1	Many models may be used to express features of a science phenomenon by showing different perspectives to view an object.	4.49 (0.68)	94.8	2.6	2.6
MR/2	Many models represent different versions of the phenomenon.	4.15 (0.83)	84.2	11.8	3.9
MR/3	Models can show the relationship of ideas clearly.	4.13 (0.72)	88.1	7.9	3.9
MR/4	Many models may be used to show different sides or shapes of an object	4.32 (0.84)	90.8	3.9	5.2
MR/5	Many models show different parts of an object	3.99 (0,99)	77.6	14.5	7.8

	or show the objects differently.				
MR/6	Many models show how different information is used	4.07 (0.84)	84.2	11.8	3.9
MR/7	A model has what is needed to show or explain a scientific phenomenon.	2.82 (1.12)	32.8	26.3	40.8
ER/8	A model should be an exact replica	3.74 (1.20)	14.5	25.0	60.5
ER/9	A model needs to be close to the real thing.	2.25 (0.98)	67.1	19.7	13.1
ER/10	A model needs to be close to the real thing by being very exact, so nobody can disprove it.	2.92 (1.27)	40.8	22.4	36.8
ER/11	Everything about a model should be able to tell what it represents.	1.90 (0.84)	84.2	10.5	5.2
ER/12	A model needs to be close to the real thing by being very exact in every way except for size.	2.81 (1.29)	47.4	18.4	34.2
ER/13	A model needs to be close to the real thing by giving the correct information and showing what the object/ thing looks like.	1.88 (0.92)	82.9	9.2	7.9
ER/14	A model shows what the real thing does and what it looks like.	2.26 (1.08)	69.8	14.5	15.7
ER/15	Models show a smaller scale size of something.	3.00 (1.31)	44.7	18.4	36.8
ET/16	Models are used to physically or visually represent something.	1.74 (0.66)	93.4	3.9	2.6
ET/17	Models help create a Picture in your mind of the scientific happening.	4.50 (0.70)	93.4	3.9	2.6
ET/18	Models are used to explain scientific phenomena.	4.01 (0.89)	76.3	18.4	5.2
ET/19	Models are used to show an idea.	3.91 (0.98)	75	17.1	7.8
ET/20	A model can be a diagram or a picture, a map, graph or a photo.	4.21 (0.98)	84.2	7.9	7.9
USM/21	Models are used to help formulate ideas and theories about scientific events.	3.79 (0.91)	71	18.4	10.5
USM/22	Models are used to show how they are used in	3.51 (0.93)	53.9	35.5	10.5

	scientific investigations.				
USM/23	Models are used to make and test predictions about a scientific event.	3.26 (1.08)	46	30.3	23.7
CNM/24	A model can change if new theories or evidence prove otherwise.	4.17 (0.68)	86.9	11.8	1.3
CNM/25	A model can change if there are new findings.	4.36 (0.71)	92.2	5.3	2.6
CNM/26	A model can change if there are changes in data or belief.	4.01 (0.87)	72.4	25.0	2.6
ME/27	Models are used by making theories.	3.38 (0.86)	50	35.5	14.4
ME/28	Tables, formulas, chemical symbols and charts are each a model	3.58 (1.18)	63.2	19.7	17.1
ME/29	Maquette and toy are each a model	4.16 (0.82)	84.2	10.5	5.3
ME/30	Newton laws, Archimedes Principle, Evolution theory, Pythagoras Theorem are each a model.	3.12 (1.17)	36.8	39.5	23.7

MR (Models as multiple representations); ER (Models as exact replicas); ET(Models as explanatory tools); USM (The uses of scientific models); CNM (The changing nature of models); and ME (Model Examples)
* Agree = Strongly Agree and Agree. ** Disagree = Strongly Disagree and Disagree

The distribution of the scores for each sub-scale of the SUMS instrument is concentrated closest to the 'agree' elective (see table 2). The ET, MR, CNM sub-scales has the most highly agreed upon responses while the USM scale and ME27, ME30 items have an even distribution between the 'not sure' and 'agree' responses. In addition, some items such as MR7, ER10, ER12, ER15 related to the subdimensions of the SUMS scale have a distribution between the 'agree and 'disagree' responses.

Table 3: Descriptive Results of the Prospective Science Teachers' Total Scores Obtained from the Atom Success Test

Atom Success Test	N	Mean	S.D.	Minimum	Maximum
	76	15.118	3.912	4.00	22.00

As can be seen in Table 3, the arithmetic average related to the total scores of the prospective Science Teachers' obtained from the Atom Achievement Test is 15.118; the standard deviation is 3.912. The minimum score the prospective Science Teachers could get from the Atom Achievement Test is 4 and the maximum score is 22.

Table 4: Frequency and Percentage Statistics of the Prospective Science Teachers' Total Scores Obtained from the Atom Success Test

Total Score	***F***	**Percent (%)**
15	8	10,53
16	10	13,16
17	11	14,47
18	9	11,84
19	3	3,95
20	4	5,26
21	4	5,26
22 (Maximum)	1	1.32
Total	50	65.79

As can be seen in Table 4, 65.79% of the participants (50 participants) scored average and above average.

4.2 Correlation Analysis Results

Correlation coefficients were computed to discover the relationships among Prospective Science Teachers' total SUMS, Scientific models as multiple representations (MR), Scientific models as exact replicas (ER), Models as explanatory tools (ET), The uses of scientific models (USM), The changing nature of models (CNM), Model Examples (ME) scales score and their total Atomic Achievement Test (AAT) score. The results were presented in Table 5.

Table 5: Results for bi-variate Correlation of the Prospective Science Teachers' Total SUMS Scale Score and Atomic Achievement Test Score

Scales	**(2)SUMS**	**(3)MR**	**(4)ER**	**(5)ET**	**(6)USM**	**(7)CNM**	**(8)ME**
(1) Atomic Achievement Test (AAT)	0.185	0.186	0.084	0.109	0.055	0.178	0.042
(2) Students' Understanding of Models in Science (SUMS)		0.637**	0.451**	0.701**	0.661	0.550**	0.615**
(3) Models as multiple representations (MR)			0.146	0.461**	0.452**	0.434**	0.327**
(4) Models as exact replicas (ER)				0.067	0.006	0.037	0.005
(5) Models as explanatory tools (ET)					0.463**	0.451**	0.398**
(6) The uses of scientific models (USM)						0.318**	0.507**
(7) The changing nature of models							0.259*

(CNM)
(8) Model Examples

** Correlation is significant at the 0.01 level (2-tailed).
* Correlation is significant at the 0.05 level (2-tailed).

The results presented in Table 5 show that there is no significant relationship between the views of the prospective science teachers on the scientific models and their achievement in the topic of Atom. Besides, the results in Table 5 imply that bi-variate correlation of SUMS scale and the five sub-scales shows a high level of correlation indicating that prospective science teachers' responses to each scale are related and consistent.

5. Conclusion

In this study the majority of the prospective science teachers responded "agree" to the MR sub-scale items (table 2, item MR1,2,3,4,5,6,7) of the SUMS scale. In the accentuation of the fact that highly abstract and non-observable phenomena are explained through multiple models (e.g., atoms, molecules, and bonds), because every model elaborates but a fraction of the target's attributes. Besides, for epistemological reasons (Harrison & Treagust, 2000) several models are used to produce and communicate chemical knowledge related to a range of phenomena (Justi & Gilbert, 2002; 2003). With this regard, the notions of the prospective science teachers about multiple representations aspects of scientific models are promising. 82.9% of the prospective science teachers agree that there is a need for a model to be close to the real thing by providing an accurate information and revealing what the object is all about (table 2, item ER13); 47.4% agree that a model is expected to be exact in each way apart from size; 40.8% of them agree that the model should be very exact, so it will be impossible to dispel it. (Table 2, item ER10); and 84.2% of them agree that each thing that has to do with a model is expected to be able to reflect what it represents (table 2, items ER11). Although, McComas (1998) pointed out the notion of "A scientific model should be an exact replica of reality" as a misconception about the nature of science, the findings consistently reveal that some learners persistently consider scientific models as exact picture of reality. The same results also have been received in other studies (Grosslight et al., 1991; Güneş et al., 2004; Harrison and Treagust 1996; Treagust et al., 2002).

Hardwicke (1995) identified this obstacle related with models and he placed more emphasis on the duty of the teacher in 'distinguishing the positive and negative analogies as clearly as possible' (p. 64) so that learners can discover the limitations of the model. Treagust et al. (2002) postulates that these results differentiate two kinds of models: a precise representation, which has correctness and elaboration; and the imprecise representation, which doesn't have the correctness and elaboration, and may be nothing like the object, but can give provision of an insight into why and how something functions. The experiences of the learners with everyday models are often related with the first type, while scientific models, particularly of the more abstract concepts, would more regularly fall into the latter scale. The relevant part is that the learners should have understanding about molecular models that they are not scale models (Hardwicke, 1995). It is with the vision that they are analogue models with different scopes and limitations that learners consider when analyzing and giving prediction of diverse properties of substances (Justi & Gilbert, 2002). The awareness of the students about the type of model to be used is very important issue when giving consideration to their understanding of the role of scientific models in learning.

Models are always used to give representation of things that are too minimal or too big to be viewed with the physical eye. Therefore, in this regard, models are the only visual representation that the students view (Treagust et al., 2002). Students make use of models to create a connection between the observed phenomena and both macroscopic and submicroscopic scientific description. Through this process, students are able to make a mental model as described by Coll and Treagust (2003). Many topics in science require students to create their own mental models. Physical representations can help students establish their own mental models and have an understanding of the new ideas. Teachers fundamentally use models and representations to help the learners create their own mental models (Justi & Gilbert, 2002; Taber, 2013). This is specifically crucial and useful for abstract ideas. In the present study, prospective science teachers have indicated a good understanding of the descriptive role of models as explanatory tools in their responses to the SUMS instrument. The majority of the prospective science teachers agree that 'models are used to physically or visually represent something' (table 2, item ET16, 93.4%) and 'Models help create a picture in your mind of the scientific happening.' Table 2, item ET17 93.4%) and that 'a model shows what the real thing does and what it looks like' (table 2, item ER14, 69.8%).

46% of prospective science teachers represented that 'Models are used to make and test predictions about a scientific event' (table 2, item USM 23); almost 45% of students indicated their uncertainty or showed disagreement that scientific models are utilized to predict , formulate theories and reveal how information is used (table 2, items USM 21, 22 and 23). In this example, the primary evidence reveals that many students do not have understanding of how scientific models are used to develop the scientific concepts and theories (Treagust et al., 2002). It is recommended that students should be encouraged to go through some experiences by using models to solve intellectual problems. Therefore, students would be exposed to an opportunity to acquire knowledge about how a model can be used as a tool of enquiry and that it is not just simply a package of facts about the world that one will have to memorize (Grosslight et al. 1991: 820).

In the current study, the large numbers of the prospective science teachers in the case of this sample of prospective science teachers from Turkey appreciate the fact that models are constructs, which are used to support scientific theories and that they become transformed in accordance with new scientific discoveries, theories or evidence by the community of science across the globe. The consistent responses of the prospective science teachers in CNM sub-scale (table 2, CNM24, 25, 26) prove that those prospective science teachers have been able to have a clear understanding of the changing nature of scientific models in reaction to transformation in scientific thinking. This aspect of models might introduce prospective science teachers to the important feature of the uncertainty of scientific knowledge and the nature of science. The understanding of the teacher about the nature of models is an integral part of their knowledge of the nature of model (Justi & Gilbert, 2003). The nature of science has been utilised to refer to the scientific epistemology, science as a way of identifying, or the values and knowledge inherent to develop scientific knowledge (Lederman, Abd-el-Khalick, Bell, & Schwartz, 2002). Assuming scientific literacy has to involve understanding of the nature and procedures by which one is able to establish scientific knowledge, the necessity of model-based teaching and learning was identified by some scholars (Boulter & Gilbert, 2000; Erduran, 2001). As Gilbert (1993) stated that modeling gives positive contribution to scientific knowledge by categorizing them into four parts (p. 9–10): *"i. Models are one of the main products of science. ii. Modeling is an element in scientific methodology. iii. Models are a major learning tool in science education. iv. Models are a major teaching tool in science education."*

The responses of the prospective science teachers to the item "Newton Laws, Archimedes Principles, Evolution Theory and Pythagoras Theorem are each a model" (table, 2, ME 30) of the ME sub-scale, which measures what the prospective science teachers take as models, are 36.8% agree and 39.5% not sure.

On the base of this finding, we can conclude that there is secondary evidence that many prospective science teachers in the case of this sample of prospective science teachers from Turkey do not have understanding of how scientific models are utilized in developing scientific concepts and theories (Treagust et al., 2002). The responses of the prospective science teachers to the item "Tables, formulas, chemical symbols and charts are each a model" are 63.2% agree, 19.7% not sure and 17.1% are disagree. 50% of the prospective science teachers agree with the idea of using models for constructing theories but %35.5 of them have no idea on this issue. These findings are consistent with Güneş et.al. (2004)'s study and imply that the prospective teachers do not have enough information about which examples are regarded as models.

In the current study, similar to Treagust et.al (2002)'s study, the bi-variate correlation analysis of SUMS instrument and the five sub-scales (table 5) shows a high level of correlation indicating that prospective science teachers' responses to each scale are related and consistent.

The findings of the present study show that there is no significant correlation in terms of statistical aspect between the views of the prospective science teachers on the scientific models and their achievements on the topic of Atom (as shown in Table 5). Yet, we might not say that there is no any relationship between these variables at all. Because as a way of creating chemical knowledge, modelling has an important role. Moreover, learning chemistry includes (Justi & Gilbert, 2002, p. 49; 2003) the followings: *"(i) coming to know the major models already produced by chemists, as well as the scope and limitations of such models; (ii) appreciating the role of models in the accreditation and dissemination of the products of chemical enquiry; and (iii) creating and testing chemical models produced by an individual and/or a group."*

Therefore, having a comprehensive understanding of models and modelling is very important for learners of chemistry. It has been postulated by Justi and Gilbert (2002, p. 62) that if learners were provided opportunities to introduce "Model of Modelling Framework' whilst acquiring knowledge about specific chemical topics, they would be capable, of creating their own models, to examine them against other models, to be able to have understanding of how and why chemical models were/are produced. And besides, it will be able to help the learners' understanding of abstract, hard core, themes in chemistry like the atomic structure, the interactions between particles, chemical equilibrium, electrochemistry and many others.

6. Recommendations

Scientific models are crucial part of the scientific process and although the function of the model and the scientific process are not often taught directly, the ideas are revealed through instances in many various topics throughout the science syllabus (Treagust et al., 2002). Harrison and Treagust, (2000) emphasizes that modeling ability is a skill of thought that is not possible to learn like a subject content. An attempt to learn to be a skilled modeler is tantamount to learning on how to write in a creative way: this can only be realized through consistent practice for a long period of time. The truth and interest of multiple models should be introduced at an early stage and constantly developed and invoked during the discussions of learning. With this perspective chemistry educators in a teacher education degree are expected to give some examples both through their personal instruction and the activities of prospective teachers; of the aspect of teaching models and how to present them to students and also strategies for the teaching of modeling abilities (Adadan, 2014; Justi & Gilbert, 2002). Teacher education authorities should think about the integration of separate scientific modeling courses to major-science teacher education departments. And also science education researchers should use the findings of this study and design more extensive studies to determine and advance the modeling abilities of prospective major-science teachers.

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