USE OF MODELS IN SCIENCE TEXTBOOKS IN AFGHANISTAN

Analysis of science textbooks of grade 10-12 of Afghan schools from a model perspective

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**ABSTRACT**

Models are very useful and are vital tools in school education, because they can improve learning and enhance students’ scientific thinking and communication. Models also contribute to students to handle science. In Afghan schools education models are mostly used in text books. Therefore, the aim of this study is to investigate that how models and their different types are used in Afghan science textbooks. To ascertain the viewpoint of science teachers on the use of models, questionnaire was developed and distributed to them in the Kabul city.

In conducting this study, quantitative method was used. For analysis all science textbooks of grades 10-12 were chosen and 120 distributed questionnaires were collected as well. First of all, the frequency of models was counted. The frequency of models in textbooks, science subjects and school grades (i.e. grade 10, 11 and 12) were compared. Second, the frequency of teachers’ views about models, importance of models, models in textbooks and in general models in science education were presented.

The result found that Afghan science textbooks of secondary education involve models. Around 86% of the second level chapters of textbooks include models. According to teachers views model are very useful for learning and teaching. Models could improve students’ scientific thinking and communication. Also teachers stated that models facilitate and ease learning process and improve learners’ participation in that process. They regarded that new and multiple models should be used in science textbooks.

**Key words:**

Textbooks, Models, Afghan Educational System, Science Education.
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Table of Content

ABSTRACT .......................................................................................................................... 1

ACKNOWLEDGEMENT ....................................................................................................... ii

LIST OF TABLES ................................................................................................................. v

LIST OF FIGURES ................................................................................................................. v

INTRODUCTION .................................................................................................................. 1

  Background ..................................................................................................................... 1
  Science Education in Afghanistan ................................................................................. 1
  Problem area ................................................................................................................... 2
  Aim .................................................................................................................................. 2
  Research questions ....................................................................................................... 2

LITERATURE REVIEW ...................................................................................................... 3

  Science and science education ...................................................................................... 3
  What are models? ........................................................................................................... 4
  Types of Models ............................................................................................................. 5
  Teaching with models .................................................................................................... 5
  Explanation of misconception ....................................................................................... 6
  Models, science and school science ............................................................................ 6
  Using comprehensible and multiple models in school textbooks ............................... 7
  Views on models (in science education) in different countries ..................................... 7

METHODOLOGY ................................................................................................................. 8

  Sampling and data collection procedures ................................................................... 8
    Text analysis ............................................................................................................... 8
    Questionnaire ............................................................................................................ 9
  Data analysis ................................................................................................................ 9
  Limitations of the study ............................................................................................... 9

FINDINGS ............................................................................................................................ 11

  Models in Science Textbooks ..................................................................................... 11
    Models and Afghan secondary education ................................................................. 11
    Inclusion of models in each science textbook ......................................................... 11
    Models in various school science subjects ............................................................... 12
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inclusion of models in different school grades</td>
<td>13</td>
</tr>
<tr>
<td>Findings from questionnaires distributed to teachers</td>
<td>13</td>
</tr>
<tr>
<td>Models in science textbooks</td>
<td>14</td>
</tr>
<tr>
<td>Models and Misunderstanding</td>
<td>14</td>
</tr>
<tr>
<td>Models relationship with real phenomena</td>
<td>15</td>
</tr>
<tr>
<td>Why teacher use models</td>
<td>15</td>
</tr>
<tr>
<td>Models in practice</td>
<td>16</td>
</tr>
<tr>
<td>Varied models in textbooks</td>
<td>16</td>
</tr>
<tr>
<td>Difficulties of using models</td>
<td>17</td>
</tr>
<tr>
<td>How teachers put models into practice</td>
<td>17</td>
</tr>
<tr>
<td>Benefits/facilities of using models in science textbooks</td>
<td>18</td>
</tr>
<tr>
<td>Findings Summary</td>
<td>19</td>
</tr>
<tr>
<td>DISCUSSION</td>
<td>21</td>
</tr>
<tr>
<td>Models and Afghan science education</td>
<td>21</td>
</tr>
<tr>
<td>Models and secondary school education</td>
<td>21</td>
</tr>
<tr>
<td>Models and science textbooks</td>
<td>22</td>
</tr>
<tr>
<td>Models and misconception</td>
<td>22</td>
</tr>
<tr>
<td>Models relationship with real phenomena</td>
<td>22</td>
</tr>
<tr>
<td>Why teachers use models</td>
<td>22</td>
</tr>
<tr>
<td>Difficulties of using models</td>
<td>22</td>
</tr>
<tr>
<td>CONCLUSIONS</td>
<td>24</td>
</tr>
<tr>
<td>REFERENCES</td>
<td>25</td>
</tr>
<tr>
<td>ANNEXES</td>
<td>27</td>
</tr>
<tr>
<td>Annex 1: Teacher’s questionnaire</td>
<td>27</td>
</tr>
<tr>
<td>Annex2: Pashto version of questionnaire for science teachers</td>
<td>31</td>
</tr>
</tbody>
</table>
LIST OF TABLES

Table 1: Inclusion of models and different kinds of models in Afghan secondary education .................. 11
Table 2: The number and frequency of models in different science textbooks of Afghan secondary school ........................................................................................................................................................................... 12
Table 3: The number and frequency of models in Afghan secondary school science subjects............... 13
Table 4: The number and frequency of models in different grades of secondary education.................. 13
Table 5: Teachers views about benefits/facilitates of models in science textbooks............................. 19

LIST OF FIGURES

Figure 1: Teachers views of multiple models in science textbooks ....................................................... 14
Figure 2: Afghan science teachers believes regarding models and misconception............................... 15
Figure 3: Teachers’ views of models relationship with reality ............................................................... 15
Figure 4: Science teachers’ views of models’ value ............................................................................... 16
Figure 5: Afghan science teachers’ views regarding importance of models in practice ...................... 16
Figure 6: Teachers’ views about use of models in textbooks................................................................. 17
Figure 7: Teachers’ opinion regarding difficulties of using models and putting them in practice ........ 17
Figure 8: Teachers’ opinion regarding putting them in practice ......................................................... 18
INTRODUCTION

Background
Generally models are the representations of ideas, objects and phenomena. Especially, in science education models are the outcome of representing of ideas, objects and phenomena where students can understand the target (i.e. phenomena, objects and ideas) with more familiar sources. For example, the sun including planets (source) could be one model of the structure of an atom (target) (Ornek, 2008). In addition, models are used to light up just external aspects of reality. In other words models are the representatives of natural phenomena. To change science into science education, it is necessary to bridge the gap between theories and reality. Therefore, it is important to use models for such duty, because scientific phenomena could be perceived by models very well. Similarly, model is the term which unlocks the door to real phenomena (Gericke & Hagberg 2010). To make learning effective, teachers should equip themselves with the knowledge regarding the models, use of the models; i.e. which model to be used at what time, which model will be preceded and followed by which model, skills of representing the models, which models might be used for the similarities of phenomenon and which models may represent the differences (Treagust, 2000). In addition, it is essential to use multiple models (e.g. picture, diagram etc) to clarify the main parts of the focusing topic and explicitly denote all the intended aspects of the concerned issue or topic (Gericke & Hagberg, 2007).

Science Education in Afghanistan
The study of science in schools is an important part of the curriculum of school education in Afghanistan. Primary (grade, 1-6) and secondary education (grade, 7-12) are categorized as major levels of school system in Afghanistan. The primary education is classified into two sub levels (i.e. lower primary and upper primary education). It has also been noticed that lower secondary and upper secondary education are integrated in secondary education. In Afghanistan, science education is not applied in lower primary school (grade, 1-3). While in other three levels (i.e. upper primary, lower secondary and upper secondary) science education is taught (Ministry of Education 2010). There are five vital subjects (biology, physics, chemistry, geology and health and environmental science) that are included in science education. In upper primary school Health and environmental science are taught as science subjects, while the other subjects are taught in secondary school education (Ministry of Education, 2010).

Since the establishment of a new government, partial improvement has been achieved. Science education is one of the fundamental issues that have been reestablished (Baha and Diakoumi, 2010). Medical science, engineering, computer science and geo-science play an essential role to unlock the door to development. Therefore, developing countries such as Afghanistan needs to improve the level of science education (Samady, 2013). Accordingly, besides school education, Ministry of Education established science centers and laboratories countrywide. Also, textbooks have been revised and updated and new version of the textbooks is applied (Ministry of Education, 2010). To improve learning achievements, it is important to update the content of science education constantly. Science education should be provided according to students’ environment and needs (Samady 2007).

Science education at schools is applied to improve students’ basic knowledge about science. Therefore, ministry of education makes efforts to enhance practical skills of teachers regarding
science centers and laboratories (Ministry of Education, 2008). Moreover, labs and materials prepared and many models and colorful pictures are used in science textbooks in order to develop the quality of teaching science and make easy learning in science classrooms (Ministry of Education, 2010).

**Problem area**

In science education it is important to teachers understand models and using of models in order to help them to use and choose models in their classrooms. Accordingly learners can understand physical world by choosing and using models. Learners engaging with models can control and predict physical phenomena. Therefore students do not have needs to memorize all materials but achieve them by using models (Ornek, 2008). Science cover broad areas but science in school is limited according the textbooks and the knowledge of teachers. Moreover, there are three actors (e.g. teacher, textbooks and curricula) which play central role in school education and take part in the process of delivering scientific knowledge (Gericke & Hagberg 2007). One vital feature of improvement of scientific knowledge is providing and using models. Models can bridge theories with a target (Drechsler, 2007). Today, constructivist learning approach use widely, which help learners to construct knowledge by themselves and modeling is one of the important constructivist teaching strategies (Harrison & Treagust 2000). As above mentioned textbooks and teachers play central role in school science education and models help to make easy learning and understanding as Matthews (2007) state if teachers provide opportunities for learners to engage with models that can contribute their learners, understanding and inquiry. Therefore, This study covers two actors that are hardly involved in school science education in order to explore science textbooks from models perspective and also find out teachers’ view regarding model. Ministry of Education (2010) claimed that the new version of the textbooks is based on models, which contributes to learning and teaching in classrooms. Therefore, this study is also intended to find out the nature of models in Afghan science textbooks of grade 10-12. Misunderstanding regarding models is the other important issue to be dwelt upon. As models are not the exact copy of reality but the representation of real phenomena, teacher and students sometime deal with misunderstanding when use models (Gericke & Hagberg 2010).

**Aim**

The aim of this study is to explore the nature of models that are used in Afghan science textbooks of grades 10-12. Efforts would also be made to find out the teachers’ view point regarding the nature and use of models in science classroom.

**Research questions**

1. How the natures of models are used and what type of models are used in Afghan school science textbooks of grade 10-12?
2. What do teachers think regarding the importance of models and how teachers encounter with difficulties when using models in school science education?
3. What do teachers think about the use of models in textbooks?
LITERATURE REVIEW

Science and science education
It is important to know science before knowing about science education. Science is the study and learning of the natural world or science is the term which study natural phenomena in the world (Gericke & Hagberg, 2010). Also “Science is about describing, predicting and finding explanation for natural phenomena in the world-as-experienced” (Gericke, 2008, p.4). The term education transforms science into science education. In other words, in this modern era the purpose of education is the production and creation of knowledge to change science into science education. Science could be enlightened as a process and product, and these features should be involved in science education (Gericke & Hagberg 2007).

Knowledge indeed is created by science for the purpose to be used not to be taught. Therefore, it is difficult to change science into science education (Chevallard, 1989). To transform science into teaching science, it is vital to link theories and reality. This task can be fulfilled through models, because models play the central role in all areas of science education. Consequently, the interrelationship between theories and reality can be improved by models very well (Gericke and Hagberg, 2010). The essential purpose of scientists is to improve an understanding of the natural world that how it works. Therefore they try to show their concepts and ideas by developing of models (Cartier et. al, 2001).

Science and school science are different and can be compared. Originally, science involves vast areas while science in school education is limited to curriculum, textbooks and the information that prepared by teachers. Consequently, science teachers cannot be scientists, because they are not familiar with scientific activities. Conversely, scientists have full access to data from multiple and complicated research activities regarding scientific phenomena, while these data cannot be practical for teachers and learners. It is difficult and might be impossible for learners to learn as scientists develop their knowledge and understanding (Gericke and Hagberg, 2007). Science education can improve and change learners’ thoughts and ideas, and make them think critically. As Chang (2008) denotes, the purpose of science is not only learning knowledge but also individuals improved thinking (e.g. critical thinking and scientific thinking) and skills.

Teachers apply different learning and teaching approaches to facilitate learning and understanding, therefore they use different techniques and methods to contribute learners’ learning. Moreover, teachers can use models to identify and clarify various topics to their learners to ease knowledge transmission. Models not only help students’ learning but could improve students’ cognition and memory (Matthews, 2007). According to the invention of new phenomena, models could be changed (Gericke & Hagberg, 2010). Therefore, students’ ideas regarding models could be changed from time to time (Grosslight et al. 1991). To improve students’ learning, teachers need to use new, simple and uncomplicated models (Gericke & Hagberg, 2007).
What are models?

Numbers of models are used in science education. Many scholars defined models differently, but most of these definitions are similar. “The term “model” is often used to describe (among other things) physical replicas of objects or systems” (Cateir et al. 2001, p.1). In addition, model is the representative of natural phenomena; it lights up the external features of actual events (Matthews, 2007; Gericke, 2008; Gericke & Hagberg, 2007). Likewise, models inspect, represent and manage order on phenomena, process and object in nature and help develop theories as well (Harré, 1970; Hempel, 1965; Hesse, 1963, 1989; Giere, 1988, 1994; Nersessian, 1992 cited in Gericke, 2008). Models are projected to clarify and classify the drawings, i.e. picture, illustrations, chart, diagram, tables and etc that have taken roots from ideas and activities (Gericke, 2008; Cartier, et al. 2001).

It is obvious that models are unreal pictures and representatives of reality. Scientists use models to generate theories regarding natural world (Cartier, et al. 2001). Also some researchers (e.g. Gericke & Hagberg, 2010) state that abstracts theories and invisible objects could be seen in models in symbolic and actual way. In addition, new phenomena can be explained with models too. Model is generated to target a specific point (Gericke & Hagberg, 2007).

Both teachers and scientists can use models for different purposes. Science teachers put it into practice to explain and describe a topic in a classroom. On the other hand, scientists use models to explore and foresee natural events. There are diverse and different types of models which can be used in learning and teaching process. A group of natural events that clarify and explain an idea are called scientific models (Cartier et al. 2001). Scientific models represent the phenomenon for a specific intention. These models are often seen to communicate information (Gericke & Hagber, 2007). There are many types of models; those models which are used for the description of features of a pattern can be called descriptive models. The behavior and structure of phenomena can be elucidated in descriptive models as well. To explain a pattern in details one could use explanatory models. When both explanatory and descriptive models are put in teaching process, these types of models are called comprehensive models (Gericke, 2008; Gericke & Hagber 2007).

Most objects can be represented by models for example: the plants, building, boats and animals. Models are used to light up external picture, structure and colors of those phenomena and can be said that model is a bridge of information that is better than concrete bridge (Harrison et al. 2000). Some models could not represent all required information and students would not learn and enhance learning. Therefore, teachers must prepare the rich box of models which might describe a phenomenon from different angles (Grosslight, et al. 1991). There are some phenomena (e.g. blood circulation) which could not be taught without models if place such kind of teaching topics in textbooks without models, learners will not catch up all the process. As mentioned, learning and teaching without models is very difficult, therefore scientist attempted to generate models to elucidate multiple phenomena, process and concepts. Models may be provided in maps, picture, diagram, chart, table and so on. Models contribute learners to talk about phenomenon (Grosslight et. al 1991). Sometime a single model cannot clarify a phenomenon (e.g. genetic process, structure of human brain) and learners become confused, therefore it is important to use multiple models. As researchers (e.g. Gericke & Hagber, 2010) denote that multiple models in science education can handle learning problems.

According to Cartier et al. (2001) models are vital components of science curricula and without models thinking about science is impossible. Teachers can support their pupils through
models in practice as models can improve students’ learning and thinking of science (Mathews, 2007). In science classrooms it is impossible to teach without models, because science education is based on both theories and models (Gericke et. al 2012). Models unlock the door to information about a phenomenon and motivate students to actively participate in science classrooms. Models also help students to work and think scientifically and enhance their prior knowledge and become more interested of science education (Harrison et al. 2000).

**Types of Models**

Generally there are two main kinds of models conceptual and mental; Conceptual models are mathematical models, computer models, and physical models, while mental models are psychological representations of imaginary or real situations (Ornek, 2008). Conceptual models can be touched and felt while mental models cannot be felt, but these models could be imagined mentally (Grosslight et al. 1991). A conceptual model is created by teachers and scientists that contribute comprehension, teaching and learning of phenomena, ideas and affairs in the world. Conceptual models are external representations of mathematical, formulation, graphs analogies of other material objects. For example the solar system can be used as a model of an atom. In addition, conceptual models are the representatives of real phenomena, objects or situation. For example, water process in pipe could be used as a model to electronic process in battery and wire. Conversely, mental models took place in a person mind as that person conceptualize and realize the situation that occurs in the world. Mental models are associated with people mind that what people have in their mind and head. For example when students visualize an earth model they construct in their mind that earth don not has any end or edge (Ornek, 2008). For instance:

It is now plausible to suppose that mental models play a central and unifying role in representing objects, states of affairs, sequences of events, the way the world is, and the social and psychological actions of daily life. They enable individuals to make inferences and predictions, to understand phenomena, to decide what action to take and to control its execution, and above all to experience events by proxy; they allow language to be used to create representations comparable to those deriving from direct acquaintance with the world; and they relate words to the world by way of conception and perception. (Johnson-Laird, 1983 quoted by Matthews, 2007, p. 649)

Likewise, according to abstract models students can construct and imagine a situation mentally, such models are used in mathematics classes (i.e. formula, equation and etc), while according to physical models, a simple plastic tube can be used as a representative of earth worms (Harrison and Treagust, 2000).

**Teaching with models**

Some researchers (e.g. Justi, 2009) stated the importance of model-based learning and teaching as a way to stimulate learners’ understanding. As model-based learning help students to construct explanations of scientific phenomena revise problems and search for information and sources. Therefore, model-based learning can be prepared a context where learners can build scientific arguments with evidence. To improve scientific knowledge models should be used as learning and teaching tools, because they could bridge theoretical and practical aspects of phenomena (Drechsler, 2007). As well as it is an important part for delivering information to students. Like in science teaching it is impossible to learn without models because models are the product of science and it is impossible to teach and learn science without models, for instance describing and explaining atoms, gens, chemical reactions and so on without using one or more models are impossible (Harrison &Treagust, 2000). For science teachers it is important
to be familiar with models and how to use models in teaching process. Teachers should know how to organize models and clearly connect their relationship with real phenomena. If some perspectives of phenomena taught through models need more explanation, teachers can bring up, use and exercise other associated models as well (Gericke & Hagberg, 2010). Moreover, only one model may not help students to learn better or sometimes students face with problem learning one subject without any models, different models of the same thing show different aspect of real things, as scientist have more than one models for the same thing therefore different models could be used to shed light on different aspect of the specific phenomena (Grosslight, et al, 1991). In addition, when teachers choose models to clarify concepts or phenomena it is very important to be aware and know about students’ needs and prior knowledge (Harrison & Treagust, 2000). According to Van Driel and Verloop (2002) teachers’ experiences and qualifications are more important to organize and clarify models. Consequently, teachers have to use specific strategies to enhance learners’ understanding and to construct linking between ideas, concepts, lesson and learning. Also teachers must improve their ability to transfer knowledge to students. As models can easily motivate students, teachers should use models according to students’ level. It is also important for teachers to select correct models for teaching science education (Harrison & Treagust, 2000). For example: ‘shell’ could be used as a model for the arrangement of electrons in atoms (Harrison & Treagust, 2000), the material globe and light bulb can make up a model of solar system which are correct and suitable models for teaching atoms and solar system (Cartier et al. 2001)

**Explanation of misconception**

As models are not the exact copy of reality but the representation of real phenomena, teachers need to prepare and introduce accurate models. Learning of falsehood has no difference with learning of truth, so students can learn from models with misconceptions. Also there are some cultural differences which affect students to misunderstand models (Gericke & Hagberg, 2010). For example: if learners see only picture of ski and skate in dictionary they learn words with misconception. If the teacher use computer and show students’ some video about ski and skate they understand better (Nilsson & van Driel 2010). Therefore, to remove misconception and misunderstanding from learning and teaching process, teachers should use computer and show videos about topics to their pupils to learn and understand better (Van Driel & Verloop, 2002).

**Models, science and school science**

The secondary school students think that models remain real world objects or events rather than representation of ideas they think the main purpose of models is communication rather than exploring ideas. Thus, scientists prepare models to set communication scientifically (Harrison et al. 2000). Experts say that models are not the recognition of twentieth century through which we know the nature. Aristotle starts his physics and the natural approach of understanding of physics with models. for teacher it might be important to understand what the students know about the phenomenon and what they don’t know and also they would know that models are the perfect and suitable way to bridge known and unknown (Matthews, 2007). Teachers would engage with models and use them as game materials, while students enjoy when playing with them (Harrison et al. 2000). It is said that when teachers use models as teaching materials, learners have different thoughts regarding models. Some of them think that models are the duplicates of real objects. Also they believe that models can be seen like real things and unclearly suppose that
model is incorrect (Grosslight et al. 1991). Besides to learn science education well, models are the tools which bridge students experience and understanding with science theories (Mettheews, 2007).

**Using comprehensible and multiple models in school textbooks**

Grosslight et al. (1991) state that learners understanding change regarding models when they are mature and expand their experience. Conceptions regarding models are different among different age student groups. Primary school pupils are undeveloped in their understanding of models. They think that model is the exact copy of reality. When learners grow up their conception about models also improves and becomes ripe, and their prior knowledge and experience affect their understanding about models as well. Hence, it is essential to provide textbooks based on models, e.g. colorful pictures, diagrams, charts, tables and so on (Grosslight et al. 1991).

It is vital to associate textbooks with models and may classify and organize variety of science disciplines with a bundle of models. It could provide learners the opportunity to learn better in a subject (Cartier et al. 2001). Teachers should use models and prepare facilities to learners to understand about the phenomena, e.g. Genetics; it is the complicated and hard part of biology. Regarding new inventions, models can be changed therefore it is important to place new models in new textbooks (Gericke & Hagber 2007). According to Van Driel and Verloop (2002) students ask questions and teachers response to their questions play a key role in teaching and learning and each model can be used for a target. Thus, it is imperative to present multiple models in textbooks to describe various parts of topic and give more details about it (Gericke & Hagberg, 2007).

**Views on models (in science education) in different countries**

Iqbal et al. (2009) state the recent views of teachers in Pakistan, and report that 44 percent think that models are the copy of reality, while 43% think that scientific models are the educated guesses of scientists. According to these teachers it is important to use models in practice. A study which conducted in Brazil pinpoints teachers’ willingness to conduct models-based teaching in science classroom as well as putting models into practice. Also they think that models-based teaching help student to develop their skills regarding models (Justi, 2009). While, the result of the study in Sweden stresses on the requirements for the teachers and textbooks authors to prepare clear models for teaching and learning in science classroom, since the models that have been used, for example for acid-base, are unclear (Drechsler, 2007). Conversely, teachers in India think that models need much preparation and require small number of students. In addition, they noted that models helps students understanding and learning and make students eager to learn, as models make learning fun and reduce learners’ mental loads (Ebenezer et al. 2004).
METHODOLOGY

Based on the research questions, this study is based on the textbooks analysis and views of science teachers regarding models. Afghan science textbooks of grade 10 to 12 were collected from the Curriculum Department of Ministry of Education and carefully studied each textbook to examine the use of models and their types. I used quantitative research method. Referring to this method I have analyzed text in the textbooks. Quantitative research approaches are used to quantify the analysis, collect and gather data through suitable data collection tools (Bryman, 2012). Moreover, through quantitative approach a bundle of facts or data can be compared with another bundle of facts or data (Punch, 2005 cited in Bell, 2010). In this study quantitative approach was used to find the frequency of models in Afghan science textbooks. In addition, the quantitative approach was used to get insight regarding the views of teachers regarding models through a predefined questionnaire.

Sampling and data collection procedures

Models could be used in science education which provide suitable environment where students can improve learning. As well as, models can improve the interrelationships between theories and reality which contribute to students understanding (Gericke & Hagberg, 2010). Therefore this study is aimed to explore Afghan Since textbooks and see the sight of models. This study interested to find out teachers views about models as well.

Data was collected through questionnaire from upper secondary schools at Kabul city through a formal letter from the side of Deputy Minister for General Education.

This study is conducted in Kabul city. Thus, in this city schools were chosen by purposeful and random sampling methods. As this study covered 11 secondary schools in Kabul city, therefore Afghan-Turk High School, and five other secondary schools (Istiqlal High School, Ghazi High School, Habibia High School, Naderia High School and Amani High School) were chosen purposefully, as there was one Afghan-Turk High school which is a semi governmental foreign private chain school in Kabul which is based on Turkish curriculum system and the other five schools were easily accessible in Kabul city. In the same bracket, the following five secondary schools (Abdullah Ansari High School, Mohmood Tarzi High School, Abdul Rahim Shahid High School, Sediquallah Rashtin High School and Mohmood Hotaki High school) are selected randomly based on the probable systematic sampling. As there are about 162 secondary schools in Kabul city and every 30th school selected.

Based on the collected data regarding the teachers’ views from the field, the views of the Afghan-Turk high school teachers were compared with the other high schools teachers’ views.

Due to the time constraints, I could not access to all schools regarding the data collection, therefore, I assigned my assistant to collect data from some schools. The data collection was undertaken in a period of approximately two weeks in September 2014.

Text analysis

In Afghanistan, textbooks are provided by government and are used by both teachers and students. As textbooks play a key role in learning process, therefore, it is important to investigate the degree of the presence of models in Afghan science textbooks. Accordingly, the whole science textbooks of upper secondary education (from grade 10 to 12) were selected for this
study. Subjects as Biology, Chemistry, Physics and Geology were chosen (10 textbooks). Before counting, models are categorized into pictures (all kinds of images and pictures), diagrams (all simple drawings without pictures, chart and table) and chart (bar chart, pie chart, lists of figures, and table). Number of those three kinds of models explored in science textbooks of secondary education and counted as frequency of models.

**Questionnaire**

In addition to the text analysis, a questionnaire was developed that included multiple choice, ranking questions and open ended questions. In quantitative research approach study would be conducted in limited time and also engaged with limited resources while this kind of studies are associated with open and varied coverage. The quantitative research approach is mostly engaged with figures, statistical measurements and numbers (Denscombe, 2010).

Questionnaires were chosen to collect data from teachers from various schools in Kabul. As well as, respondents could fill in with stress-free mind and personalized information (Cohen, 2010). As in this study analyzed science textbooks of grade 10-12, therefore the prepared questionnaire (which is based on literature review having 18 questions in its fold) distributed to 140 upper secondary schools teachers.

**Data analysis**

After the data was collected, it was compiled and analyzed. According to research questions this study is based on quantitative research approach. Accordingly science textbooks were analyzed and also teachers’ views were explored. Quantitative approach was used to analyze collected data numerically regarding textbooks analysis and teachers questionnaire. A unit of text that provides obvious information about models was selected for further analysis. Consequently, I have referred to analyze the text under the second level chapters in each textbook. Regarding text analysis, efforts were made to count the frequency of models used in textbooks. In this connection, I read all the selected textbooks of grade 10-12 and specified the second level chapters. The identified chapters were reviewed and grasped the models which were categorized into pictures, diagrams and charts. Similarly, the data that has been collected through questionnaire were entered into excel sheet by gender, age and teachers education and experience. As well as, collected data were coded, categorized, sorted, and summarized the relevant information in tables and charts and presented in text. This data was examined in order to find out the percentage of models in different subjects consist of biology, geology, chemistry and physics textbooks of grades (10-12).

Summarized information which was sorted in charts and tables were compared. According to text analysis, school grades (10, 11 and 12 grades), subjects (biology, geology, physics and chemistry) and kinds of models (picture, diagram and chart) are compared. Summarized information which was collected through questionnaire compared as well. As Afghan-Turk High School teachers’ views compared with other ten schools teachers’ views.

**Limitations of the study**

This study has some limitations that have direct impact on interpretation of the findings. First of all, efforts were made to find out a baseline study conducted on the textbooks analysis from models perspectives. Based on the unavailability of such information, the outcome of this study could not be compared to other similar data.
Since the data collection tools were based on the structured questionnaire, filling in it without the verbal directions and guidance may have created some problems which were dully predicted in the study.

In addition, as the letter for permission was from the side of Ministry of Education, because there were doubts concerning the honesty of some of the answers as some school teachers might have filled the questionnaire in consultation with each other to keep the high school fame well. As I saw the collected questionnaires, the answers were not the same and were different from each other, therefore the results are reliable.

From all 140 questionnaires, 20 were not returned because some said that they have lost them.
FINDINGS

The data collected under this study both textbook analysis and questionnaire has been organized in two subchapters for further analysis. It includes text analysis and findings from teachers’ questionnaires. Findings are shown in tables, diagrams and charts.

Models in Science Textbooks

The textbooks analysis was conducted extensively and there are ample proofs of inclusion of models in Afghan science textbooks. In this connection 10 science textbooks of grade 10-12 were analyzed. In this analysis the amount and types of models in different textbooks of high school in Afghanistan are explored.

Models and Afghan secondary education

In this study the use of models are categorized into pictures, diagrams and charts. This study revealed that there are about 793 second level chapters in all the science textbooks of grade 10-12. Table 1 show that most of these chapters are based on models which compose 86% of all second level chapters, while only in 14% of all second level chapters models could not be seen. As seen in table 1 below, it was found that diagrams are the models which are used more than other types of models in textbooks of science education of grade 10-12. When frequencies of the models were computed it was found that diagrams constituted half of models that are embodied in science textbooks of upper secondary school education. On the other hand, pictures are in the second position (31%), while the uses of charts go on third position (18%) (See table 1). Moreover, as shown in tables 2-4, it could be stated that diagrams are used to a large extent in each textbook each subject (biology, chemistry, physics and geology) and each grade (10, 11 and 12), of upper secondary education.

This table indicates the mostly regarded models are diagrams, which are almost used to 51% of all kinds of models.

Table 1: Inclusion of models and different kinds of models in Science books of grade 10-12

<table>
<thead>
<tr>
<th>Models in textbooks</th>
<th>Picture</th>
<th>Diagram</th>
<th>Chart</th>
<th>Model</th>
<th>chapters do not including any model</th>
<th>Total # of Second level chapters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>213</td>
<td>343</td>
<td>123</td>
<td>679</td>
<td>114</td>
<td>793</td>
</tr>
<tr>
<td>Percent</td>
<td>31</td>
<td>51</td>
<td>18</td>
<td>86</td>
<td>14</td>
<td>100</td>
</tr>
</tbody>
</table>

Inclusion of models in each science textbook

The science textbooks of grades 10 to 12 were separately analyzed of use of model in them and a comparison was made to find differences in use of models in these science subjects. Table 2 denotes the inclusion of models in each textbook. From models perspective, generally each textbook has models, but with a little differences. Biology of grade 12 and 11, and chemistry of grade 11 include slightly high proportion of models from 11 to 13%. Other science and similarly
the textbooks of upper secondary education include models with approximately same proportion and range from 8 to 10%.

Table 2: The number and frequency of models in different science textbooks of Afghan secondary school

<table>
<thead>
<tr>
<th>Grade</th>
<th>Textbook</th>
<th>Picture</th>
<th>Diagram</th>
<th>Chart</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Biology</td>
<td>Frequency</td>
<td>29</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>4</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Grade 12</td>
<td>Chemistry</td>
<td>Frequency</td>
<td>15</td>
<td>26</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>2</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>Grade 12</td>
<td>Physics</td>
<td>Frequency</td>
<td>6</td>
<td>47</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>1</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Grade 11</td>
<td>Biology</td>
<td>Frequency</td>
<td>36</td>
<td>48</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>5</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Grade 11</td>
<td>Chemistry</td>
<td>Frequency</td>
<td>19</td>
<td>36</td>
<td>29</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>3</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Grade 11</td>
<td>Physics</td>
<td>Frequency</td>
<td>13</td>
<td>48</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>2</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td>Grade 10</td>
<td>Biology</td>
<td>Frequency</td>
<td>32</td>
<td>12</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Grade 10</td>
<td>Chemistry</td>
<td>Frequency</td>
<td>21</td>
<td>21</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Grade 10</td>
<td>Physics</td>
<td>Frequency</td>
<td>15</td>
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<td></td>
<td></td>
<td>Percent</td>
<td>2</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Grade 10</td>
<td>Geology</td>
<td>Frequency</td>
<td>27</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Percent</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>Frequency</td>
<td>213</td>
<td>343</td>
<td>123</td>
<td>679</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>31</td>
<td>51</td>
<td>18</td>
<td>100</td>
</tr>
</tbody>
</table>

**Models in various school science subjects**

In Afghanistan, science education is an important part of school education. Regarding secondary schools, subjects of science education are included: biology, chemistry, physics and geology (Ministry of Education, 2010).

Table 3 illustrates the amount of models within these science subjects. In general, all of these subjects are designed to contain models and facilitate the process of learning from the models perspective. This existence of models in three subjects (i.e. biology, chemistry and physics) is very similar which range between 29 to 32%. On the other hand, geology includes fewer models than other three subjects which mount up 8%. Pictures, diagrams and charts represent patterns, pathways and relationships that are easily visualized by students. Every subject presents many issues and topics and the use of models (types of models) also related to the nature of topics and phenomena. For examples the periodic table, weather maps, circuit diagrams, metabolic pathways, blood circulation picture and so on. Teachers can use different kinds of models such as pictures to motivate student. They should be able to choose correct models (Harrison & treagust, 2000).
Table 3: The number and frequency of models in Afghan secondary school science subjects

<table>
<thead>
<tr>
<th>Science Subject of secondary education</th>
<th>Picture</th>
<th>Diagram</th>
<th>Chart</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biology</td>
<td>Frequency</td>
<td>97</td>
<td>100</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>14</td>
<td>15</td>
<td>3</td>
</tr>
<tr>
<td>Chemistry</td>
<td>Frequency</td>
<td>55</td>
<td>83</td>
<td>72</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>8</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Physics</td>
<td>Frequency</td>
<td>34</td>
<td>137</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>5</td>
<td>20</td>
<td>4</td>
</tr>
<tr>
<td>Geology</td>
<td>Frequency</td>
<td>27</td>
<td>23</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>4</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>Frequency</td>
<td>213</td>
<td>343</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>31</td>
<td>51</td>
<td>18</td>
</tr>
</tbody>
</table>

Inclusion of models in different school grades
Table 4 depicts the inclusion of models in textbooks of each grade. This table shows that all grades include a model perspective with approximately similarly relative frequency between 27 to 36% of all second levels chapters that are based on models.

Table 4: The number and frequency of models in different grades of secondary education

<table>
<thead>
<tr>
<th>Different grade of secondary education</th>
<th>Picture</th>
<th>Diagram</th>
<th>Chart</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade 12</td>
<td>Frequency</td>
<td>50</td>
<td>113</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>7</td>
<td>17</td>
<td>5</td>
</tr>
<tr>
<td>Grade 11</td>
<td>Frequency</td>
<td>68</td>
<td>132</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>10</td>
<td>19</td>
<td>6</td>
</tr>
<tr>
<td>Grade 10</td>
<td>Frequency</td>
<td>95</td>
<td>98</td>
<td>43</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>14</td>
<td>14</td>
<td>6</td>
</tr>
<tr>
<td>total</td>
<td>Frequency</td>
<td>213</td>
<td>343</td>
<td>123</td>
</tr>
<tr>
<td></td>
<td>Percent</td>
<td>31</td>
<td>51</td>
<td>18</td>
</tr>
</tbody>
</table>

Findings from questionnaires distributed to teachers
Questionnaires were distributed to 140 school teachers, while 120 of grade 10-12 teachers in Kabul city responded through filling in the questionnaires. To ascertain the view point of respondents, teachers of a private run school Afghan-Turk High School and public schools in Kabul city were selected regarding models for comparison. Therefore, 20 questionnaires were filled in by Afghan-Turk High School teachers and 100 questionnaires were responded by other school teachers (i.e. Habibia High School, Mahmood Tarzai high school etc), while 20 questionnaires were not returned. In this part of study, teachers’ views classified into three main
sections (e.g. Afghan-Turk High School teachers views, other than Afghan–Turk high school teachers views and views of both classes in general).

Models in science textbooks

Figure 1 shows the views of science teachers in Kabul City regarding multiple models in textbooks. According to this figure majority of science teachers strongly agreed that multiple models should be presented in schools science textbooks. 40% of Afghan-Turk High school teachers strongly agreed with multiple models to be used in textbooks, while more than 50% of other science teachers strongly agreed to place different models in science textbooks.

![Bar chart showing teachers' views on multiple models in science textbooks.]

Figure 1: Teachers views of multiple models in science textbooks

Models and Misunderstanding

Figure 2 indicates that a large number of Afghans science teachers are strongly agreed that teachers should use computer and video discs for presenting models to remove misunderstanding about models in science classrooms.
Figure 2: Afghan science teachers’ views regarding models and misconception

*Models relationship with real phenomena*

Figure 3 shows that most of science teachers in Kabul city strongly agreed that models should be well connected with the real phenomena and clearly connect them with reality. While 80% of Afghan-Turk High Schools teachers are agreed to well connect models with reality.

Figure 3: Teachers’ views of models relationship with reality

*Why teacher use models*

Figure 4 illustrates that most of Afghan-Turk high school teachers (70%), majority of other teachers in Kabul city and both groups (Afghan-Turk and other schools teachers under this study) of teachers in general think that they use models to improve students’ learning. A minority of both groups of teachers in Kabul think that models can enhance students’
encouragement and participation in science classrooms. Conversely, Afghan-Turk teachers do not think that models can enhance students’ communication.

Figure 4: Science teachers’ views of models’ value

Models in practice

Figure 5 shows that majority of teachers under this study put models into practice to explain a topic in science classrooms. Also about 30% of them use models to enhance student scientific thinking. While some of them use models so that students handle science and improve their critical thinking. Only 30% of Afghan-Turk teachers think that models can transform science into science education.

Figure 5: Afghan science teachers’ views regarding importance of models in practice

Varied models in textbooks

Figure 6 indicates that generally, most of the teachers under this study like newest models to be placed in textbooks. Conversely, 40% of Afghan-Turk High school teachers share their opinion that it is important to use multiple models in textbooks. Also 10% of them are interested with complicated models, while other Afghan teachers under the study do not think so.
Figure 6: Teachers’ views about use of models in textbooks

**Difficulties of using models**
Figure 7 explains the opinion of teachers under the study regarding models through open question in distributed questionnaires. This table shows that most of Afghan-Turk teachers (60%) think that lack of professional competency with subjects is the big difficulty regarding using models in science classrooms. Conversely, the majority of other teachers under the study in Kabul perceive unfamiliarity with models as a difficulty. While, at all 63% teachers of both groups think that unfamiliarity with models could be a big difficulty of using models.

<table>
<thead>
<tr>
<th></th>
<th>Afghan-Turk high school</th>
<th>Other schools in Kabul city</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>%</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A. newest models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B. uncomplicated models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C. complicated models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D. multiple models</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E. a single models</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

Figure 7: Teachers’ opinion regarding difficulties of using models and putting them in practice

**How teachers put models into practice**
Figure 8 also describes the opinion of Afghan teachers regarding models through open question in distributed questionnaires. This data in this figure indicates that 90% of Afghan-Turk High school teachers use models according to topic requirements. On the hand, 48% of other teachers of the study say, they use models regarding students’ needs and also 21% of them only use models which they have in school laboratory. Whereas, the same number (about 40%) of teachers under this study use models according to pupils and topics needs.
**Figure 8: Teachers’ opinion regarding putting them in practice**

**Benefits/facilities of using models in science textbooks**

Table 5 points out that the majority (70%) of Afghan-Turk High school teachers think that models in textbooks improve learning achievement. While 50% of them are on the view that it is most important to use models in textbooks through which theories can be bridged with reality, see invisible objects and enlighten external shape and structure of phenomena and ideas. As Gericke and Hagberg (2010) state that the interrelationship between theories and reality can be superior by models very well. One aim of the textbook is to develop students’ ability to use theories in their everyday life and it could be fulfilled by models when engage with textbooks (Gericke, 2008). Similarly, most of other school teachers under the study (64%) in Kabul think that models in textbooks are used to explain phenomena and ideas and regarded it as most important. Contrary to Afghan-Turk High School teachers, 62% of teachers under the study in Kabul city opine and recognize the importance to have models in textbooks which help to set communication scientifically. Generally in Afghanistan models in textbooks are used to describe phenomena and set communication scientifically and consider them as most important in the ranking.
Table 5: Teachers views about benefits/facilitates of models in science textbooks

<table>
<thead>
<tr>
<th>Q18: What are the most important benefits/facilitates of having models in science education (science textbooks)?</th>
<th>Facilitate learning</th>
<th>Improve learning achievement</th>
<th>Improve learners’ critical thinking</th>
<th>Bridge theories and reality</th>
<th>Elaborate ideas, terms and phenomena</th>
<th>To be seen Invisible object</th>
<th>To light up external shape, structure and colors of phenomena</th>
<th>Thinking about science is impossible without models</th>
<th>Models motivate students to actively participate in</th>
<th>To set communication scientifically</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td>Ranks; 1 is low and 5 is the high</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
<td>Percentage</td>
</tr>
<tr>
<td>Afghan-Turk High School</td>
<td>1</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>0</td>
<td>0</td>
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<td>23</td>
<td>10</td>
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</tr>
<tr>
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<td>6</td>
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<td>30</td>
<td>38</td>
<td>48</td>
<td>62</td>
<td>18</td>
<td>41</td>
</tr>
</tbody>
</table>

Findings Summary

As well as, this study investigated models in different textbooks, subjects and grades. Result shows that most of models were placed in biology textbooks of grade 11 and 12 and chemistry textbook of grade 11, while the other science textbooks included few models. This is shown that all science textbooks of secondary education in Afghanistan are not based on models similarly. It is important that all science textbooks have a wide number of models and it would be placed according to the topic needs. Models are important for all science textbooks. As Gericke (2008) denotes that to
improve learners understanding of science education they have to meet models, in different science subject.

The result from questionnaires indicated that generally teachers in Kabul City think that newest and multiple models are vital to be used in science textbooks. While some of Afghan-Turk high school teachers like complicated models to be placed in textbooks. Unfamiliarity and unprofessionalism are the big obstacles regarding use of models in science classrooms as most of teachers responded that lack of professional teachers and skills of using models are the big problems in Afghanistan. And that Afghan Turk school is different in views in regard to models use.
DISCUSSION

The discussion is based on the findings chapter, and focuses on the textbooks’ models and teachers’ views on the use of models.

Models and Afghan science education
Models are associated with science and are imperative for learners, because through models students can achieve scientific understanding (Harrison et al. 2000). Also models help students to catch up the meaning of scientific phenomena (Gericke & Hagberg 2010). It is essential for science education; to learners achieve scientific knowledge (e.g. Chang Rundgren & Rundgren, 2010) and this goal could be fulfilled by using models in science classrooms (Gericke & Hagberg 2007). It could be stated that science textbooks of Afghan secondary education are based on a model perspective. The same result found out from teachers’ questionnaires. All the teachers responded that Afghan science textbooks of secondary education meet a models perspective. It should not be seen as enough to use just textbooks models; Ministry of Education should regard models as a vital part of science education.

As well as, the study explored that most of Afghan-Turk teachers think that unfamiliarity with subject is the big problem in order to use models in science classrooms, while the large number of other teachers in Kabul city incapability with models regard as a problem. This is shown that Afghan teachers are encountered with both of these problems. These problems can effects on science education in Afghanistan, because subjects’ knowledge and knowledge of models help to select and choose correct, simple and correlated (i.e. the models that are linked with discussed phenomena, issues and topics) models. Nilsson (2009) Denotes that teacher Professionalism with subject or knowledge about subject content and understanding of the structure and the nature of discipline led teacher to confidence in teaching a subject. Regarding models Gross light et al, (1991) state that it is important to know models and use them correctly. To improve understanding of models, it would be better to understand the nature (i.e. types of models, use of multiple and simple models in teaching and etc) of model through which can lighten on different aspects of the phenomena. Therefore it would be vital to teachers understand and be familiar with both subject and models.

The study also found out that the majority of Afghan-Turk teachers use models according to the requirement of topics, while half of other teachers in the study use models based on needs of learners. Some of those teachers see schools laboratory when use models. For teacher it is essential to have knowledge that what students know and what they do not know and use models to fulfill their requirements (Matthews, 2000). To develop students’ learning it is needed to link models with phenomena, objects and ideas (Nilsson, 2009). Accordingly, it is important that teachers should know the use of models and link them with discussing phenomena, ideas and objects.

Models and secondary school education
This study found that Afghan secondary education involved a models perspective. According to the importance of models it may be important to place more models in every grade in the degree of needs. Period of secondary education is essential for pupils because they are being ready for higher education and models are very important for this period of education, because models improve learning achievements and help in transferring of knowledge to learners (Harrison et al.
2000). Therefore this period of education selected as focal area of this study.

**Models and science textbooks**
Teachers in Afghanistan view that newest and multiple models are vital to be used in science textbooks. As well as, these teachers think that, multiple and newest models must be placed in Afghan science education, as most of them responded that it is essential to use multiple and newest models in science education. Likewise, researchers (e.g. Gericke & Hagber, 2010; Gericke & Hagberg, 2007) state that newest and multiple models in science education can handle learning problems and improve students’ learning. Also Gericke & Hagberg (2007) denoted that simple and uncomplicated models should be used in science textbooks because it could make lesson easy and improve learners’ understanding.

**Models and misconception**
Afghan science teachers think that to eradicate and remove misconception and misunderstanding regarding models, teachers should use computers and videos for presenting models. Similarly, Van Driel & Verloop (2002) also refer to computer and videos to be used in science classrooms for describing models. While in Afghanistan, the majority of teachers do not access to computers and labs. Some of the schools have computers labs but need electricity. Therefore, Ministry of Education should attempt to provide computers and labs for teachers to use it in teaching and learning process.

**Models relationship with real phenomena**
According to this study, lack of professional teachers and skills of using models regarded as big problems in Afghanistan, therefore Ministry of Education should attempt to employ skillful and professional teachers to all schools in Afghanistan. This effort could contribute learning and teaching which would improve learning achievements, because they might be able and have the skills of using models in classrooms. Conversely, models could improve learning when well connect them to reality (Gericke & Hagberg 2010). Only professional and skillful teachers could implement models and well connect them to reality (Gericke & Hagberg, 2007).

**Why teachers use models**
Afghan science teachers use models to explain topics and enhance learners understanding. As well as, some of them use models to improve pupils’ participation, scientific thinking and encouragement to handle science and improve their previous knowledge. As many researchers regarded about; that by using models theories could be bridged with reality. Also based on this study, models can enhance learners’ scientific thinking, communication and participation in science classrooms. Through models learners can handle science and improve their learning achievements (Gericke and Hagberg, 2010; Gericke & Hagber, 2007; (Harrison et al. 2000).

**Difficulties of using models**
This study shows that unfamiliarity and unprofessionalism are the big obstacles regarding using models in science classrooms in Afghanistan. It is the effects of unfamiliarity and professionalism that Afghan teachers only use schools lab and they cannot provide any model by themselves. Conversely, teaching with models is very important; teachers must be skillful and
professional to understand models and have good skills of using of and teaching with models (Gericke & Hagberg, 2010).
CONCLUSIONS

This study undertook two key issues in Afghan textbook particularly in science subjects. First, the inclusion of models in textbooks and its utility were discussed and second the views of science teachers regarding models were ascertained. The study found out that 679 second level chapters including models were found in Afghan science textbooks which make up 86% of all second level chapters in the textbooks of grade 10-12. The findings show that Afghan science textbooks include a models perspective. The study also examined the view point of Afghan science teachers regarding models. They considered the use of models very important in teaching and learning. As they pointed out; models can improve learning achievement, learners’ scientific thinking and communication. According to teachers’ view newest and multiple models should be used in science textbooks.

Besides models in textbooks, teachers are expected to improve their teaching. They could use different and useful models in science classrooms. They are urged to use new and multiple models. In order to develop learners understanding, teachers can use picture, diagram, chart and plastic materials in their teaching (Harrison and Treagust, 2000).

Since most of the teachers stated that their unfamiliarity with models and lack of subject qualification are impeding teaching in applying models in science classrooms. Therefore, to improve teachers understanding about models Ministry of Education needs to build the capacity of science teachers. There is also a dire need for the Ministry of Education of recruiting qualified teachers in Afghan schools.

At all, the aim of this study was to analyze science textbooks of grade 10-12 and this study conducted with teacher’ views regarding models as well.

In this study both qualitative and quantitative research methods were used, because the study was engaged with text analysis and teachers questionnaires. In qualitative method, data analysis mostly based upon researchers interpretation. Therefore if the same study be repeated by another researcher the results might be different. However by using careful and clear categories, grids and unit of text analysis and teachers questionnaires I believe these the overall results are valid and reliable.

In this area findings of this study contribute to the existing knowledge and are based upon the literature review. In fact this study has a narrow focus only exploring models and teachers views regarding models within science textbooks of grade 10-12. There are many other textbooks in other educational levels and in other subjects (science textbooks of grade 4-6 or 7-9, science textbooks of TTC and university) that were not explored in this study, but other researches could be done in future studies.
REFERENCES


Justi, R. (2009) *Learning how to model in science classroom: key teacher’s role in supporting the development of students’ modeling skills*. University of Minas Gerais, Brazil


ANNEXES

Annex 1: Teacher’s questionnaire

Teacher’s Profile

Age .................

Sex:  Male □  Female □

Education:  (Please select one option based on your highest level of education)

- Primary □  Secondary □  Teacher Training Colleges □  University □
- Islamic Education (Madrasa) □  other please specify ------------------ □

Teaching Experience:

Years of teaching: .................

Teaching Class:  Boys □  Girls □  Mixed □

Teaching Level/Grade:  Primary □  Secondary □

Please first of all pay your attention to the brief description about models and then read the direction and instruction regarding every part of the questionnaire and follow accordingly.

What are models?
The term model usually explains reply of objects physically. In addition, model (i.e. table, chart, diagram, picture, plastic’s material and so on) is the representative of natural phenomena; it lights up an external feature of actual event. Also, models inspect, represent and manage order on phenomena, process and object in nature and develop theories as well. It is clear that models are unreal pictures of reality. Therefore, scientist use models to generate theories regarding natural world, and science teachers put it into practice to explain and describe a topic in a science classroom.

Questions:

1. Teachers can use models as game materials, and students enjoy when playing with them

Strongly Agree - Agree - Neither Agree or Disagree - Disagree - Strongly Disagree

2. In your point of view, it is imperative to present multiple (several models for describing a specific phenomenon) models in textbooks to describe various part of topic and give more details about it.
3. Models are used to elaborate on unreal picture of reality.

4. To remove misconception and misunderstanding regarding models teachers should use computer and show videos (clips of phenomenon) about topics to their pupils to learn and understand better.

5. According to you, could abstract theories and invisible objects be seen in models in symbolic and actual way?

6. Teachers have to arrange models and clearly connect its relationship with real phenomena.

7. Regarding new inventions models can be changed therefore it is important… Please select one of the most relevant and important option.
   A. To place new models in new textbooks
   B. Teachers should demonstrate it in the classroom
   C. To be unconsidered

8. Why teachers use models? Please select one of the most relevant and important option
   A. To enhance students learning
   B. To enhance students encouragement
   C. To enhance students communication
   D. To enhance students participation
   E.

9. Do you use models?
   Yes, No

10. If yes, at what time
    A. At the beginning of the lesson
    B. In the middles of the lesson
    C. At the end of the lesson

11. Do you think that it is important to science teacher put models in practice to explain and describe a topic in a classroom?
    Yes, No
A. If yes, select one of the most relevant and important reasons using models according to you
   B. Improve students’ critical thinking
   C. Improve students’ scientific thinking
   D. Improve students’ ability to handle science
   E. Improve students’ communication
   F. To transform science into science education
   G. To explain a topic

12 Are Afghan school science textbooks based on models?
   Yes ☐   b) No ☐

13 If yes, at which level is it the most important
   A (lower primary) b (upper primary) c (lower secondary) d (upper secondary)

14 To improve students’ learning textbooks must be based on… (Please select one of the statement with which you agree and circle the letter).
   A. newest models
   B. uncomplicated models
   C. complicated models
   D. multiple models
   E. a single model

15 According to you, what are the difficulties of using models in science classrooms? Please write your opinion below.

.................................................................................................................................
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.................................................................................................................................

16 How do you put models in practice? Please write your opinion below.

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.................................................................................................................................
17 What are the most important benefits/facilitates of having models in science education (science textbooks)?

Please rank the least important benefits/facilitates as 1 and the most important benefits/facilitates as 5.

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<thead>
<tr>
<th>benefits/facilitates</th>
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<th>2</th>
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<tbody>
<tr>
<td>Facilitate learning</td>
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<tr>
<td>Improve learning achievement</td>
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<tr>
<td>Improve learners’ critical thinking</td>
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<tr>
<td>Bridge theories and reality</td>
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<tr>
<td>Elaborate on ideas, terms and phenomena</td>
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<tr>
<td>To be seen invisible object</td>
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<tr>
<td>To light up external shape, structure and colors of phenomena</td>
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<tr>
<td>without models thinking about science is impossible</td>
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<tr>
<td>Models motivate students to actively participate in science classrooms</td>
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<tr>
<td>To set communication scientifically</td>
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</table>
Annex 2: Pashto version of questionnaire for science teachers

د پښویکی پوښتنلیک

د پښتنن پاتي شمیره:....................

عمر:........................................ کلن

جنس:

ناخیه □ بنخیه □

مهمانی وکرنه د لاندی خوابونو خمه یو خواب انتخاب کری (تحصیل درجه).

د پوهنتون خمه فارغ □ د معلیمن خمه فارغ □ د دولسم خمه فارغ

اسلامی تعیینات .................................. کاله

یا کوم بل ولیکی ................................. کاله

د استادی تجربه ................................. کاله

جا ته درس ورکوی:

هلاکن □ گ/انجوني او هلاکن □ انجوني

مهمانی وکرنه د لاندی خوابونو خمه یو خواب انتخاب کری.

په لیسه کی درس ورکوی □ په لوسرنی پښویکی کی درس ورکوی □

له هر خمه نه مخکی د مامل په اره لنډو تشريحاو ته مراجعه وکرئ او روسته د پښتنلیک هره برخه (پښتنینی) لنده معرفی

لري و په لیسه او دجاجی په تولو پښتنئو ته خواب ورکر.

منابع:

د مامل اصطلاح په معمول دول د اجسامو، پدیمو او موضوعاتو وی عکس دی. همدارنکه مامل چی عبارت دی له چارت،

جدول، نیاکرام، تصویر او براساسکی شیانو خمه چی د طبیعی پښتو نمایده بلل کوری او ددغه پښتو ظاهره شکل په پو

دول حقیقت سره معرفی کوي. په مامل کښی کښی کورین کوری چی د پښتو نه ته نماییده چی وشي او بی اداره شي. همدغه مامل

دی چی د تیبریو د منخه یاره او تفصیل لپاره استعمالی. ماملونه په حقیقت کښی د طبیعی پښتو او پیدیمو په غیره

وافقي انخور خه نه ساینس په وی یه طبیعت کی او ساینسی علومو استادان تری په تولکی کی گته اخلي چی یه

موضوع په په بی دول سره تشريح او روسته کری.
مهربانی وکړی د لاندی ځوابونو څخه یو خواب انتخاب کړی

۱. استادان مولونه دلیلی دنیا په دول استعمالوی چې بیه زده کرې رامینځ ته شی او شاملونه خوب او چې پری لوبی کوی او درس بیه زده کوی.

په پوره توکه ډېرې چې بیه مواقف نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۲. ستاسو په نظر آیا د اسکور diamond کی دول دول مولونه وکارول شی؟ موضوع به اساتد شی او دیر تشريحات به شی وراندی کری.

په پوره توکه ډېرې چې بیه مواقف نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۳. ستاسو په نظر آیا دا مولونه ده تی لیاره استعمالوی چې د واقعیتونو یو غیرې واقعى تصویر روبانه کری.

په پوره توکه ډېرې چې بیه مواقف نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۴. ستاسو په نظر آیا دا مولونه او غلط فکر او غلطه په ویژن پوره توکه ناموفق نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۵. ستاسو په نظر آیا نا لیدنکي شیان هم کیدای شی؟ ق چې د مولونه په واسطه به سمبولیک دول سره ولیدل شی.

په پوره توکه ډېرې چې بیه مواقف نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۶. استادان مجبور دی چې مولونه بشن منظم کری او له موضوعات او پدیدو سره به تراو ورکری.

په پوره توکه ډېرې چې بیه مواقف نه بیه مواقف نه بیه مواقف ناموفق په پوره توکه ناموفق

۷. د نوی اختراعاتو مطابق مولونه هم بدیل نه دا مهمه ده چې ... مهربانی وکری یو مناسب، ترلی او مهم خواب په ننیه کری.

A. په درسی کتابونو کښې شامل شی
B. استادان بیه په تولکی کی وکاروی
c. له نظر خه و غورخرول شی

۸. استادان ولی مولونه استعمالو؟ مناسب... مهربانی وکری یو مناسب، ترلی او مهم خواب په ننیه کری.

A. چې دهو کونکو زده کرې لوره شی
B. چې د دهد کونکو لوره شی
c. چې د دهد کونکو محاره یا کمونیکیشن لوره شی
d. چې د دهد کونکو برخه اخیسته بیره شی

۹. آیا ته مولونه استعمالو؟

A. نه
B. هو
10. که خواب مو هو یی؟ په کوم وخت کی؟... مهربانی وکړی یو مناسب، ترلی او مهم خواب په نینه کری.

A. درس په شروع کی
B. درس په منځ کی
C. درس په اخر کی

11. ایا ته په دی‌دی آند بی‌چی د ساینسی علومو استادان دی ماډلونه په تولکی کی تمرین او استعمال کری د خو موضوع پننه روښانه کری؟

A. یو مهم علت یی په نښه کړی
B. د زده کوونکو کریتیکل فکر لوړی
C. د زده کوونکو علمی فکر لوړی
D. د زده کوونکو فلسفی لوړی
E. د زده کوونکو پیچلی لوړی
F. د زده کوونکو ساده لوړی

12. ایا افغان ساینسی درسی کتابونه د ماډلونو درلودونکی دی؟

A. هی
B. نه

13. ایا افغان ساینسی درسی کتابونه د ماډلونو درلودونکی دی؟

A. هی
B. نه

14. که خواب مو هو وی یو مهم علت بی په نینه کری؟

A. بی‌پورت لومړی ښوونځی (۱-۳)
B. پورتینی ښوونځی (۴-۶)
C. بی‌پورت لیسه (۷-۹)
D. پورتینی لیسه (۱۰-۱۲)

15. چی د زده کوونکو زده کری بهبه لوره کری نو مهمه د کی درسی کتابه نه مهربانی وکری یو مناسب، ترلی او مهم خواب په نینه کری؟

A. نوی او تازه ماډلونه ولری
B. ساده ماډلونه ولری
C. پیچلی ماډلونه ولری
D. هی دول ماډلونه ولری
E. پورت له ماډلونه ولری

16. د سی‌په نظر بی‌چی د ساینسی تولکی کی د ماډلونه په استعمال کی کوم مشکلات وجود لری خیل نظر مو لاندی ولیکی
17. Taso madolone xe dol aestumalo xel
18. Pe Science bo wanda ya Science umoom (Science disi kitabone) gh d madolone d aestumal konti o Asestiaryo xe dix

<table>
<thead>
<tr>
<th>konti ya Asestiaryo</th>
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<th>2</th>
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<tr>
<td>zhe xere asante xe koi</td>
<td>dze koi lashe raorege zhe xere</td>
<td>dze koi xere atanade ya kriyikl xere ajtew</td>
<td>dntwro o hewqef tramxh jure</td>
<td></td>
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</tr>
<tr>
<td>aepiaro, ecwmbi o cemtjnh o yedii robonhe koi</td>
<td>ne xelorhe xelorhe dliro o xerhe</td>
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<tr>
<td>d mwstwnto, pineshe o yedii xarjhe shkel o jwntjnh twptoh o robonhe koi</td>
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<tr>
<td>le madolone nhe ber de Science he xere he koi xel na mewken dix</td>
<td>madolone xere xeronekhe tsheqkhe koi chhe Science he xere koi xel he furehe</td>
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<tr>
<td>dze koi xere tramxh ummi bheh o mahorhe juro</td>
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