An Analysis of the Sixth Grade Science Curriculum in Light of the levels of Cognitive Domain of the New Version of Bloom's Taxonomy

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Abstract:

The aim of this study was to analyze the 6th grade science curriculum in Saudi Arabia in terms of the levels of cognitive domain of Bloom's Taxonomy. The study was carried out in two units: the materials, and science helps human. The analysis of the textbook was through analyzing words and images. The analyzed data were divided into a number of categories 1- Objectives; 2- New Concepts and Definitions; 3- Illustrative Pictures and Descriptions; 4- Activities; 5- Evaluation. Then, the results of the analysis have been compared with Bloom's Cognitive Taxonomy in order to place them into an appropriate level in the Taxonomy. The findings show that the contents of the two units mainly concentrate on the first three levels in the Taxonomy; remembering, understanding, and applying. Unfortunately, there were limited of the two units' contents meet the advanced three levels of the Taxonomy; analyzing, evaluating, and creating.

Keywords: Science Curriculum, Bloom's Taxonomy, Primary Schools, Gifted Education, Documentary Analysis

1. Introduction:

Saudi Arabia recognized the importance of meeting the needs of gifted children in the mid 20th century. In 1968, the educational policy in Saudi Arabia stated that, each student has the right to develop his/her talent, and his/her ability. However, no programmes or real educational services were adopted until 1995, when the Ministry of Education started a programme called “Talent Search” (Ministry of Education in Saudi Arabia, 1998).

In 1998, the Ministry of Education in Saudi Arabia established a number of gifted education centres around the country. Afternoon and Thursday programmes for the gifted are the main task of the gifted centres during the school year, while summer camps are the biggest annual event for gifted students. For example, between 2003 and 2008, sixteen summer programmes were run yearly in several universities around the country (King Abdulaziz & His companions foundations for the Gifted, 2008). Other enrichment programmes have been held in computer science and engineering in King Fahd University (Atas and Twfeek, 2006). In 2006, about 760 students attended similar programmes around Saudi Arabia (King Abdulaziz & His companions foundations for the Gifted, 2008). Moreover, in August 2006, the first international conference on gifted children was held in Saudi Arabia. Scholars from 26 countries, such as the UK, the USA, Germany and China, were invited to the conference in Jeddah city. Programmes have been established in many cities in the country. A programme called “Gifted Education within Schools” was started by the Ministry of Education in 2002 which were pull-out programmes. Currently, the King Abdulaziz Foundation for the Gifted (KAGF) is establishing different programmes for gifted secondary, high school and university students. All these programmes are in science and technology (King Abdulaziz & His companions foundations for the Gifted, 2008). Saudi Arabia is therefore developing a broad range of programmes, designed towards nurturing gifted people within and outside schools.

However, there is still a need for more programmes to help the gifted in schools, because schools are the best place to provide extra programmes and give attention to gifted students (Aljughaiman, 2005). In addition, all gifted programmes in schools in Saudi Arabia are delivered outside regular classrooms.

2. Critical Background:

The picture of public education has changed considerably throughout the last three decades. The number of students - both boys and girls - has increased from 104,738 in 1960 to 5,019,007 in 2009. Moreover, the world requires education to be developed in quantity of students and quality of learning simultaneously.

This section will highlight some of the results of Arsheed *et al.'s* (2003) work on the science curriculum in Saudi Arabia that are pertinent to the study presented here. Arsheed *et al.'s* project studied the science curriculum in all primary and secondary schools in Saudi Arabia from 1988 to 2002.

Arsheed *et al.* (2003) analysed the contents of the science curriculum in the primary stage against several standard factors. However, only some of those factors have been highlighted here because they are particularly relevant to the current study in relation to one of its aims; that is to examine the current science textbook in 6th grade in its adequacy to meet the needs of gifted students. These factors are:

1. Attention to individual differences;
2. Meeting the pupils' needs, interests, tendencies and concerns;
3. Development of the capacity to research and survey;
4. Care of the environment and social problems.

2.1 Attention to Individual Differences:

As the scientific content in the primary stage is common to all students, this means that there is no formal interest in individual differences, which confirms the lack of optional subjects for the education of certain gifted students. Researchers, teachers and supervisors agree that the scientific content of the science curriculum at the primary level does not take into account individual differences among students and does not clearly specify what is to be taught to the gifted and to others.

Arsheed *et al.'s* (2003) results showed that the science curriculum at the primary stage in Saudi Arabia partly meets the needs and concerns and the tendencies of students. However the needs of gifted students do not seem to be specifically addressed. Therefore, educators and researchers in Saudi Arabia should undertake more studies about these factors for gifted students, and not just consider the needs, interests, tendencies, and concerns of average students.

2.2 Meeting the Pupils' Needs, Interests, Tendencies and Concerns:

Arsheed *et al.* (2003) stated that there is a need to develop the scientific content of the science curriculum, to take into account the individual differences between the various categories of students. As a result, developing the contents of the science curriculum will allow for more differentiation of scientific activities. In addition, Arsheed *et al.* (2003) recommended that the science curriculum should have some scientific activities that are specifically designed for gifted students.

2.3. Development of the Capacity to Research and Survey:

Research results showed that the scientific contents of the science curriculum of the primary stage is poor and it does not develop students' capacity to research and survey (Arsheed *et al.*, 2003). The majority of methods that are used in books and classes focus on memorization; this method is not appropriate for developing the ability to research and survey using scientific information. Moreover, in order to develop the ability in gifted students to research and survey, the science curriculum should be designed and built with consideration of the views of scientists, experts in education, teachers, as well as students. Arsheed *et al.* (2003) showed that there is a need to pay more attention to developing research and survey skills, especially for gifted students so that the science curriculum is designed to cater for the needs of this group. Thus, one aim of this research is to analyse the science curriculum to examine in detail whether the content of units provides sufficient opportunity for gifted students to engage in research and survey.

2.4 Care for Environmental and Social Problems:

Arsheed *et al.* (2003) showed that there is agreement from researchers, teachers and supervisors that the science curriculum in Saudi Arabia in the primary stage gives special consideration to the environment, while social problems are not given the same attention. From the above, it seems that there is a need to increase the awareness of topics on social problems.

To sum up, the science curriculum for the primary stage in Saudi Arabia does not pay sufficient attention to several important factors discussed above. It would appear that the students' needs in terms of knowledge, development of attitudes and concerns are not adequately addressed in the science curriculum for the primary stage in Saudi Arabia. In addition, the topics of social problems are not adequately addressed, and the content lacks topics that can enrich the science curriculum to meet the needs of average as well as gifted students. If these were addressed the science curriculum would be enhanced not only for the gifted, but for all students. It could be said that there is a need to design a curriculum to meet that needs of gifted students that is based on empirical research conducted by specialists in this field.

3. Thinking and Research Skills :

There are many types of thinking addressed in the fields of psychology and education. Examples of these are: scientific, empirical, analytic, logical, critical, and creative thinking. The thinking skills of the gifted have been delineated by a number of researchers (Renzulli, 2000; Lipman, 2003; Cottrell, 2005). There are many thinking skills that tend to be used and practised by the gifted, not only those that can be taught. One of the most famous models, which has been used frequently to develop thinking skills in students, is Bloom’s (1956) cognitive domain taxonomy (Maker and Nielson, 1995). The original framework of this cognitive taxonomy includes six categories of thinking skills: knowledge, comprehension, application, analysis, synthesis and evaluation. All categories were labelled as ‘abilities and skills’. Later, Anderson *et al.* (2001) modified Bloom’s cognitive domain taxonomy:

The original number of categories, six, was retained, but with important changes. Three categories were renamed, the order of two was interchanged, and those category names retained were changed to verb form to fit the way they are used in objectives (Krathwohl, 2002:214). The categories in the Anderson *et al.* (2001) revision are remember, understand, apply, analyse, evaluate and create. Table 1 shows the details of the six new categories in the revision of Bloom's Taxonomy.

Table 1: Structure of the Revised Taxonomy

1. *Remember* – Retrieving relevant knowledge from Long-term memory.	***1.1 Recognizing*** ***1.2 Recalling***
2. *Understand* – Determining the meaning of instructional messages, including oral, written, and graphic communication.	***2.1 Interpreting*** ***2.2 Exemplifying*** ***2.3 Classifying*** ***2.4 Summarizing*** ***2.5 Inferring***
3. *Apply* – Carrying out or using a procedure in a given situation.	***3.1 Executing*** ***3.2 Implementing***
4 *Analyze* – Breaking material into its constituent parts and detecting how the parts relate to one another and to an overall structure or purpose.	***4.1 Differentiating*** ***4.2 Organizing*** ***4.3 Attributing***
5. *Evaluate* – Making judgments based on criteria and standards.	***5.1 Checking*** ***5.2 Critiquing***
6. *Create* – Putting elements together to form a novel,coherent whole or make an original product.	***6.1 Generating*** ***6.2 Planning*** ***6.3 Producing***

From Table 1 it could be said that the first two levels (remembering and understanding) are necessary for all students, and that all students should be encouraged to develop higher skills (Davis and Rimm, 2010). However, it is expected that gifted students will develop higher-level cognitive skills, including applying, analysing, and evaluation and creating. Taber (2007) suggests that curricula or teaching and learning programmes for gifted students should include extension in depth and enrichment in breadth, which means these programmes should provide additional support and challenge in the classroom and outside school. In addition, an important issue in challenging learners is to build activities based on the higher levels of thinking (Watts and Jesus, 2007). Taber and Corrie (2007) suggest that teaching of gifted students in science should emphasise questions and activities that enable the learner to apply, analyse, evaluate and create.

The study is guided by the following research question:

What are the contents of the current science textbook in the sixth grade at public schools in Saudi Arabia in terms of learning demand?

4. Methodology:

This study uses documentary analysis as a tool to analyse the textbooks of the science curriculum. This instrument has been selected to answer the research question. The goal of the analysis is first to look at the contents of the textbook and to examine the extent to which the textbooks match cognitive demand, as defined by Bloom's Taxonomy (David R. Krathwohl *et al.*, 1964). The methodology used to analyse the selected science textbook is quantitative. The steps in the analysis of textbook are:

1. Choosing the categories (Arsheed *et al.*, 2003);
2. Comparing the categories with Bloom's Taxonomy;
3. Presenting results.

4.1.Choosing the categories:

this step was undertaken by reading the textbook several times to develop an understanding of its form, structure and contents which gives the researcher a very good level of understanding of the content (Maslak, 2008) and the structure of the science curriculum.

The in-depth reading will enable the categories to be selected in the second step. The categories are derived from the analysis of the science textbook and from some studies which highlighted the principles of the components of a textbook (Arsheed *et al.*, 2003; VanTassel-Baska and Brown, 2007). The important issue here is that it should be possible for the categories to be used or applied by other researchers or readers who are looking at the same contents, such that they would obtain the same or comparable results (Berg, 2007; Devetak *et al.*, 2010). Thus, *this may be considered a kind of reliability of the measures and a validation of eventual findings* (Berg, 2007: 306).

The analysis of documents (e.g. textbook) should also be related to the literature and the research questions (Berg, 2007).

4.2 Comparing the categories with Bloom's Taxonomy:

Bloom's Taxonomy has been used as a guide to judge whether the textbook meet the six levels of cognitive demand. *Bloom's taxonomy has been widely adopted as a model for conceptualising higher level thinking skills for gifted learners* (VanTassel-Baska, 1994a:303). Thus, the current study has used Bloom's Taxonomy as a guide to judge whether the science textbooks meet the needs of gifted students. Intra-rater reliability is a type of reliability assessment in which the same assessment is completed by the same rater (www.medicine. mcgill.ca). To demonstrate intra-rater reliability, the researcher analysed two complete units of the science textbooks. After one month later, the researcher analysed the same units. The percentage of agreement was 90 %. These reliability indices adequately demonstrate dependability of the method in this study. The identified categories as a result of step 1 divide the science textbook into the following: 1- Objectives; 2- New Concepts and Definitions; 3- Illustrative Pictures and Descriptions; 4- Activities; 5- Evaluation. Then, the units (unit 5 and 6 of the science textbook of 6th grade) are compared with Bloom's Taxonomy of cognitive demand (Remembering, Understanding, Applying, Analysing, Evaluating and Creating (Taber, 2007) and (http://www.coe.uga.edu/epltt/bloom.htm) - see Figure 1 and Table 2).

5. Presenting results:

The results are presented thematically both quantitatively using descriptive statistics: numbers and percentages, and via qualitative descriptions

The science textbook in the 6th grade contains six units. Each unit has two or three chapters and each chapter has a different number of lessons. Five units of the textbook have been analysed. Then, two units were chosen as a sample for this study.

The selected units are Unit 5 (”Materials”) and Unit 6 (“Science Helps Humans”). These units were selected based on the subjects covered. The content of Unit 5 is chemistry; this is the study area and background of the researcher. Unit 6 is about applications of science, within which the related subject is using chemistry in our lives (e.g. drugs); this also relates closely with the researcher’s field of knowledge.

Table 2: Original and New Bloom’s Taxonomies (www.iste.org)

Level	Original	New
1	(low) Knowledge	Remembering
2	Comprehension	Understanding
3	Application	Applying
4	Analysis	Analysing
5	Synthesis	Evaluating
6	(high) Evaluation	Creating

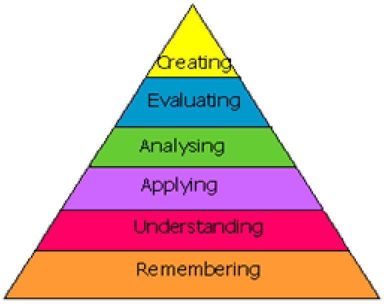

Figure.1: A new revision of Bloom’s Taxonomy (Forehand ,2005)

Science textbooks are the primary sources used by science educators throughout the world to guide them in teaching the content and skills prescribed in curricula (Stoffels, 2005). In Saudi Arabian schools, there is a considerable emphasis on textbooks in science classes, not only by teachers but also by students (Arsheed *et al.*, 2003). Science textbooks are regarded by the Ministry of Education as the primary source of information in all schools.

The goal of the analysis is to look at the contents of the textbook and to examine the extent to which it matches cognitive demand, as defined by Bloom's Taxonomy. In order to answer the research question, the study employed several steps: 1. Choosing the categories; 2. Comparing the categories with Bloom's Taxonomy; 3. Presenting results.

General Information about the Textbook

The nature of the Saudi grade 6 science textbook is discussed here to provide contextual information. The cover sheet contains one image, the title and the date of publication. The second page contains the names of the authors and the reviewers and the remainder of the divided into several components.

The introduction to the textbook includes four main parts. The first part includes the major aims of science teaching in primary schools in Saudi Arabia and the goals of the science textbook at this level. The second part is directed to science teachers and focuses on their role in classes. The third part is directed to the parents and provides some advice on how to help and support their children in their study of the science textbook. The last part is directed to the student and includes some advice to encourage them how to be researchers and scientists.

There are six units in the science textbook. Each unit has several different chapters. The units cover different subjects in science (e.g. physics, biology, and chemistry). Some of these units consist of two or three chapters. Each chapter consists of several topics, which form the sub-sections of the chapter

Table 3: The Subjects of each unit in the 6th grade science textbook

Unit	Chapter	Subject
(1) The Human Body	1	Skeleton
	2	Muscle and Movement
	3	Nervous System
(2) Reproduction	4	The Importance of Reproduction
	5	Reproduction of Birds and Mammals
(3) Our Environment	6	The Environment and Us
	7	The Effect of Humans on the Environment
	8	Relations between the Creatures in the Environment
(4) Electricity and Magnets	9	Electricity
	10	Magnets
(5) The Materials	11	Combined, Elements and Compounds
	12	Metals and Rocks
(6) Science Helps Humans	13	Science Helps Humans to Improve Telecommunication
	14	Science Helps Us to Save our Health

Table 4: General features of the science textbook

	Chapters		Topics		Pages	
	Chapters	% of Chapters of the textbook		%		%
Unit 1	3	21.5%	13	22%	21	16%
Unit 2	2	14%	10	17%	17	13%
Unit 3	3	21.5 %	9	15%	25	19%
Unit 4	2	14%	13	22%	33	25%
Unit 5	2	14%	9	15%	25	19%
Unit 6	2	14%	5	9%	11	8%
Total	14	100%	59	100%	132	100%

Table 4 summarizes the general features of the science textbook. Unit 4 consists of 33 pages of the textbook which accounts for 25% of the total text book, forming the biggest part of this book. Units 3 and 5 are the next biggest units, each consisting of 25 pages (22%). Unit 6 is the shortest unit at only 11 pages (8%). There are 59 topics: Units 1 and 4 each consist of 13 topics (22%). Unit 2 consists of 10 topics (17%), while units 3 and 5 each consist of only 9 topics (15%).

Units 5 and 6, on "Materials" and "Science Helps Humans" were chosen for analysis as they are the most relevant subjects to the researcher. These units are long enough to be representative as a sample of the whole textbook and this proportion is acceptable given the nature of this research.

The following paragraphs provide details of the steps that were used to analyse the Science Textbook (ST).

Step1: Choosing the categories: the science textbook was read several times to develop an understanding of its form, structure and contents. This gave the researcher a very good level of understanding of the content and the structure of the science textbook. In addition, it helped him to think about the categories that would be selected. Decisions were made about the categories of analysis. It is important that the categories used in the analysis are replicable: i.e. that they can be used again by any researcher to give the same results when analysing the same contents.

The analysis of Units 5 and 6 of the textbook was performed through analysing both words and images. All the contents in Units 5 and 6 were divided into a number of categories: 1- Objectives, 2- Definitions, 3- Illustrative and Description Pictures, 4- Activities, and 5- Evaluation.

Step 2: Comparing the categories with Bloom's Taxonomy: Bloom's Taxonomy was applied to the results of the analysis to identify the proximity of the units to this taxonomy. Later, because some of the contents did not fit into any categories, such as resources, learning independently, and using advanced technology, the study moved on to analyse these contents qualitatively. This step was chosen to cover all the materials and matters in the science textbook.

Step 3: presenting the results: the analysis of both Units 5 and 6 were presented against Bloom's Taxonomy.

5.1 Analysis of Unit 5

Table 5 (see Appendix A) shows the analysis of Unit 5 according to Bloom's taxonomy. Unit 5 consists of two chapters (11 and 12). There are 19 objectives, 9 definitions, 12 images, 21 educational activities and 7 evaluation questions. Comparison has been made between these results and the cognitive demand of Bloom's Taxonomy. The majority of the objectives involve "remembering" (57%), while the level of "understanding" is 31% and the level of Applying is only 10%. At the same time, no objective is related to the higher levels of analysis, evaluating and creating, in this unit.

The levels of remembering, understanding and applying all have the same percentages (33%) in the category of definitions, while the percentages of the levels of analysis, evaluating, and creating are 0%. The levels of understanding and applying have good percentages (50% and 41%) in the category of images and pictures, while remembering accounts for only 8% of images and pictures in this unit. Most of the educational activities in this unit fall into the level of applying (57%), followed by understanding (28%), while, remembering, analysing and creating each account for only 5% of activities. The educational activities contain no cases at the level of evaluation. The evaluation element of this unit is focused only on the first two levels of Bloom's taxonomy, which are remembering and understanding (71% and 29% respectively). These are examples from the ST that will illustrate some level of thinking skills included;

Understanding: *What will be happened if we mix up the salt with water?*

Applying: *In our daily life, we use a lot of elements and mixtures, please fill the gaps with suitable answers in the Table below:*

Mixtures used in daily life		**Elements used in daily life**	
Name of mixture	**Use area**	**Name of element**	**Use area**

This indicates that most of the contents of unit 5 have been designed to meet the first three levels of thinking skills of Bloom's taxonomy. These levels are the lowest levels of thinking. Only two of the activities included in this unit meet the higher levels of thinking, namely analysis and creating. This suggests that unit 5 should be redesigned to give more opportunities for gifted students to expand their skills, especially in the higher levels of thinking. Furthermore, the unit does not include any content addressing the skills of evaluating.

Evaluation questions in this unit did not cover all the objectives, as some objectives were left without measuring some of these skills. For example, there are only 7 evaluation questions in unit 5, while there are 19 objectives.

5.2 Analysis of Unit 6:

Table 6 (see Appendix B) shows the analysis of unit 6 against Bloom's Taxonomy. Unit 6 consists of two chapters (13 and 14). There are 9 objectives, 6 definitions, 3 images, 15 educational activities and 4 evaluation questions. Most of the chapter's objectives are focused on the levels of applying and understanding (44% and 33% respectively), followed by remembering (22%). There are no objectives related to the levels of analysing, evaluating or creating in this unit. The definitions in this unit meet only two levels of thinking, which are remembering and understanding (67% and 33% respectively).

The level of applying accounts for the largest percentage of material (67%) in the category of images and pictures, while understanding accounts for 33% of images and pictures in this unit. Most of the educational activities in this unit meet the level of applying (53%), followed by analysing (27%). Creating is third, with 13% of the activities falling into this category. Only 6% of the educational activities may be classed as meeting the level of evaluating.

The majority of the evaluation questions in this unit are focused on the lowest level of Bloom's Taxonomy, which is remembering (75%). The second level is applying, which accounts for 25% of the questions. None of the evaluation questions meet other levels of Bloom's Taxonomy.

These findings indicate that the majority of the contents of unit 6 have been designed to meet the first three levels of thinking skills of Bloom's taxonomy. These levels are the lowest levels of thinking. Some educational activities in this unit meet higher levels of thinking (e.g. analysis), which is represented in a reasonable number of activities. Moreover, the level of creating is found in two of the fifteen activities (13%), which is a good rate compared with other thinking skills in this unit. The results reveal that the unit's objectives do not include any thinking skills at the levels of analysing evaluating, or creating, although some of its activities give the students opportunities to practice these skills. This means that the objectives in this unit do not reflect the level of skills of the activities. For example, the textbook asks the student to:

"Discuss with older people about the diseases that affected people in the past, and how people were expected to deal with these types of diseases, and then write a report about what you find. Then, discuss your reports with your teacher and classmates".

This example contains some higher-order skills (e.g. applying, analysing and creating), which is good for the students.

On the other hand, the objectives of this unit do not include or meet these levels of skill. This suggests that the textbook authors must ensure that outcomes of the textbook reflect the objectives. Unit 6 should give more opportunities for gifted students to expand their skills, especially the higher levels of thinking. In addition, the unit does not include any content at the level of evaluating. For example, the objectives of the Unit 6 include three objectives which meet lower levels of thinking:

The students will be able to:

(Applying): *draw the shape of a wave;*

(Remembering):*remember how the sounds transfer throughout the air*

(Remembering and Applying): *remember how the sounds transfer throughout the TV, Radio, and phones.*

Overall, the quantitative analysis of Units 5 and 6 indicate that there are several important issues to be taken into account in designing a science textbook.

Both units have suitable numbers of activities that meet the first three levels of thinking (remembering, understanding and applying). Moreover, there are some activities that aim to develop higher levels of thinking (analysing, evaluating and creating). However, the numbers of tasks and activities are generally too low. Most of the activities entail direct application of knowledge. Thus, the units should be redesigned to improve all levels of thinking, not only the lowest levels. In addition, there is a clear need to increase the number of evaluation questions to cover all the learning objectives. For example, the total number of evaluation questions in both units is 11, while the total number of objectives is 28. In addition, most of these questions focus on the first two levels of thinking, except for one, which meets the level of applying. Moreover, the level of evaluation should be included for all activities and all levels of thinking.

The findings of the analysis of the ST showed that the majority of its contents only meet the first three levels of thinking skills of Bloom's taxonomy.

6. Discussion:

There was a clear picture across all the findings of the current study that the thinking skills contained in the ST do not exceed the lower order of Bloom's Taxonomy. This highlights the need to improve the ST to meet the higher level of thinking required by our gifted students. Halpern (2003:2) states *that the information explosion is yet another reason why we need to provide specific instruction in thinking.* Thomson (2006) emphasized that the development of gifted education is necessary to ensure that students have opportunities to develop their abilities and skills to become the future intellectual, social, economic and cultural leaders.

The findings from the analyses of the ST showed that the majority of the skills in the ST are focused on remembering, understanding and applying. The analysis of the ST showed that more than 50% of the materials are at the level of applying.

Unit 5 contains few materials that address the levels of analyzing, evaluating or creating. On the other hand, Unit 6 has a good level of material at the levels of analyzing and creating. This implies that the majority of skills are lower than the students require. This is in line with Purcell *et al.* (2002), who found that *the gap between current curricular units and learning needs of gifted and talented learners is immense*. Many programmes have been established to develop gifted students‟ thinking skills, but these aspects are not included in science textbooks (Purcell *et al.*, 2002; Adams and Pierce, 2008). VanTassel-Baska *et al.* (2007) examined eleven different programmes designed to meet the needs of gifted students. One of the main purposes of these programmes was to increase the level of thinking skills of all students, including gifted students. The programmes showed *some evidence of effectiveness with gifted learners* (VanTassel-Baska, 2007:351). Furthermore, Gady (2006) mentioned that there were many reasons to include and develop higher order thinking skills in gifted programmes, because these programmes would prepare students for their real life, improve learners‟ social lives and help students to cope with the complexity of life and decision-making. Based on the above view, the importance of higher-order thinking skills is clear, and students should be enabled to participate in lessons and practical experiments that include a range of these skills (Gady, 2006).

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