The role of Astronomy education in daily life

Ashrafoalsadat Shekarbaghani

Correspondence:
Assistant Professor in Physics
Department of Science & Mathematics Education of Education Studies Research Center,
Organization for Educational Research and planning(OERP),
Iran, Tehran
Email: a20.baghani@gmail.com

Abstract

This research has been done in the interests of preparing a thorough guidance curriculum for astronomy education in secondary educational level. So the present research has a developmental goal and methodologically it has been done by diacritical analytical method. It has been devised according to the culture and civilization of Islam and proportionate to the daily needs of modern world science in order to be able to explore future scientific, economical and social needs. We are faced with these four elements on the cultural, religious and educational level in this study too. So the present study tries to interpret the commercial situation of astronomy, religious culture and curriculum. For data gathering we used library and documental techniques in this research. The used documents include finished project reports, articles, books, theses, national curriculum and finally basic evolution of the educational system in the Islamic Republic of Iran. Meanwhile the most important concluding findings are the creation of preparations for the needed science for the compilation of astronomy affecting daily life with the other curriculum.

Key words: Astronomy education, daily life, curriculum Guidance, secondary.

Please cite this article as: Please cite this article as: Ashrafoalsadat Shekarbaghani. The role of Astronomy education in daily life.
World Family Medicine. 2017; 15(8):141-147.
DOI: 10.5742/MEWFM.2017.93067

Introduction

Throughout History humans have looked to the sky to navigate the vast oceans, to decide when to plant their crops and to answer questions of where we came from and how we got here. It is a discipline that opens our eyes, gives context to our place in the Universe and that can reshape how we see the world. When Copernicus claimed that Earth was not the centre of the Universe, it triggered a revolution. A revolution through which religion, science, and society had to adapt to this new world view.

Astronomy has always had a significant impact on our world view. Early cultures identified celestial objects with the gods and took their movements across the sky as prophecies of what was to come. We would now call this astrology, far removed from the hard facts and expensive instruments of today's astronomy, but there are still hints of this history in modern astronomy. Take, for example, the names of the constellations: Andromeda, the chained maiden of Greek mythology, or Perseus, the demi-god who saved her.

Now, as our understanding of the world progresses, we find ourselves and our view of the world even more entwined with the stars. The discovery that the basic elements that we find in stars, and the gas and dust around them, are the same elements that make up our bodies has further deepened the connection between us and the cosmos. This connection touches our lives, and the awe it inspires is perhaps the reason that the beautiful images astronomy provides us with are so popular in today's culture.

There are still many unanswered questions in astronomy. Current research is struggling to understand questions like: "How old are we?", "What is the fate of the Universe?" and possibly the most interesting: "How unique is the Universe, and could a slightly different Universe ever have supported life?" But astronomy is also breaking new records every day, establishing the furthest distances, most massive objects, highest temperatures and most violent explosions. Pursuing these questions is a fundamental part of being human, yet in today's world it has become increasingly important to be able to justify the pursuit of the answers.

Although we live in a world faced with the many immediate problems of hunger, poverty, energy and global warming, we argue that astronomy has long term benefits that are equally as important to a civilized society. Several studies have told us that investing in science education, research and technology provides a great return, not only economically, but culturally and indirectly for the population in general, and has helped countries to face and overcome crises. The scientific and technological development of a country or region is closely linked to its human development index, a statistic that is a measure of life expectancy, education and income (Truman, 1949).
There are other works that have contributed to answering the question "Why is astronomy important?" More recently, C. Renée James wrote an article outlining the recent technological advances that we can thank astronomy for, such as GPS, medical imaging, and wireless internet (Renée James, 2012). In defence of radio astronomy, Dave Finley in Finley (2013) states, "In sum, astronomy has been a cornerstone of technological progress throughout history, has much to contribute in the future, and offers all humans a fundamental sense of our place in an unimaginably vast and exciting universe."

Astronomy and related fields are at the forefront of science and technology; answering fundamental questions and driving innovation. It is for this reason that the International Astronomical Union's (IAU) strategic plan for 2010–2020 has three main areas of focus: technology and skills; science and research; and culture and society (International Astronomical Union, 2012).

Although "blue-skies research" like astronomy rarely contributes directly with tangible outcomes on a short time scale, the pursuit of this research requires cutting-edge technology and methods that can on a longer time scale, through their broader application make a difference.

A wealth of examples show how the study of astronomy contributes to technology, economy and society by constantly pushing for instruments, processes and software that are beyond our current capabilities. The fruits of scientific and technological development in astronomy, especially in areas such as optics and electronics, have become essential to our day-to-day life, with applications such as personal computers, communication satellites, mobile phones, Global Positioning Systems, solar panels and Magnetic Resonance Imaging (MRI) scanners.

Several reports in the US (National Research Council, 2010) and Europe (Bode et al., 2008) indicate that the major contributions of astronomy are not just the technological and medical applications, but a unique perspective that extends our horizons and helps us discover the grandeur of the Universe and our place within it. On a more pressing level, astronomy helps us study how to prolong the survival of our species. For example, it is critical to study the Sun's influence on Earth's climate and how it will affect weather, water levels etc. Only the study of the Sun and other stars can help us to understand these processes in their entirety. In addition, mapping the movement of all the objects in our Solar System, allows us to predict the potential threats to our planet from space.

Educating on astronomy

Astronomy has always had a significant impact on our world view. Early cultures identified celestial objects with the gods and took their movements across the sky as prophecies of what was to come. We would now call this astrology, far removed from the hard facts and expensive instruments of today's astronomy, but there are still hints of this history in modern astronomy. Take, for example, the names of the constellations: Andromeda, the chained maiden of Greek mythology, or Perseus, the demi¬god who saved her. Now, as our understanding of the world progresses, we find ourselves and our view of the world even more entwined with the stars. The discovery that the basic elements that we find in stars, and the gas and dust around them, are the same elements that make up our bodies has further deepened the connection between us and the cosmos. This connection touches our lives, and the awe it inspires is perhaps the reason that the beautiful images astronomy provides us with are so popular in today's culture. There are still many unanswered questions in astronomy. There are other works that have contributed to answering the question "Why is astronomy important?" Dr. Robert Aitken, director of Lick Observatory, shows us that even in 1933 there was a need to justify our science, in his paper entitled The Use of Astronomy (Aitken, 1933). His last sentence summarizes his sentiment: "To give man ever more knowledge of the universe and to help him 'to learn humility and to know exaltation', that is the mission of astronomy." More recently, C. Renée James wrote an article outlining the recent technological advances that we can thank astronomy for, such as GPS, medical imaging, and wireless internet (Renée James, 2012). In defence of radio astronomy, Dave Finley in Finley (2013) states, "In sum, astronomy has been a cornerstone of technological progress throughout history, has much to contribute in the future, and offers all humans a fundamental sense of our place in an unimaginably vast and exciting universe."

Shekarbaghani et al (2009) on the feasibility of astronomy education based on Islamic culture and civilization in general and secondary education, favorable conditions for the study of astronomy education, the situation in the various sectors of education, ground for the implementation of the astronomy education in all countries, the global challenges and astronomy education program were examined. According to the findings of this study, the best method for the teaching of astronomy in schools is to utilize various departments of the Ministry of Education, including the Institute for the Intellectual Development of Children and Young Adults and research centre which should be equipped with the various tools which are necessary for Astronomy education for students. Using the capabilities of the private sector, including astronomy Amateur, Astronomy Association and the Association for the training courses will help in the shortest possible time to provide astronomical education for the students of the country. In survey research facilities, student research center we

found that, there are many films on astronomy education, replicas, posters, maps and an astronomical atlas of the night sky, are available from which many of them are taken and distributed by amateur astronomy associations.
Zühtü Okulu et al (2009), show that applied education of Astronomy in civilized life is one of the important goals. It means that this process can be used for identifying Astronomy and the goals of Astronomy education. It means that there is an answer for the other question in this research.

Krumenaker (2009), looked at fully independent, self-contained astronomy courses available to students in grades 9-12, with the mixed-methods study. Therefore, courses, such as physics or earth science, that contain some astronomy units were not considered in this study. The data came from high school astronomy teachers via a survey available to them on a Webpage and as a Word file. The study mirrored but greatly enlarged the scope of the Sadler study. Quantitative and categorical questions included diverse topics such as instructors' back- grounds, planetarium and telescope availability, financial support, course content, student demographics, school AYP status, and other items. Also included were open-ended survey questions, such as requests for recommendations about ways to go about starting a course, and these responses were coded and treated with qualitative or quasi-quantitative analyses.

•Alvandi(2010) studied the evolution of astronomy education in Iran from Dar ul-Funun up to now. Findings from this study indicate that: the population of the study consisted of 1,090 volumes of books on the topics of physics, geography, geology and geometry. Of these, 363 were selected for the sample as a sample of the 7 was not available in the archives of 356 cases that were analyzed. In addition, the entire collection of books at Dar-Al fonon school, also were added, including 15 titles: "7 titles in Physics, 4 as geometry, 2 as geography and 2 as knowledge of the earth (geology)", with the description of the sample population of this study being 386 titles. The present collection of textbooks may all be relevant. These studies revealed that the titles of textbooks in the discussion on astronomy education firstly depended on the largest share of physics and secondly geography in Iran.

• Shekarbaghani(2010) did a Comparative study of Astronomy education between Iran and the target countries to study astronomy education programs in order to provide various and appropriate benchmarks in the field to provide full coverage. This is included in the findings of the final report of the project:
• The United States of America is one of the target countries in this comparative study. In the United States, in the context of science education standards, programs are intended for astronomy education in school. It is clearly defined as to what kind of educational content should be understood by students in these standards and what kind of process skills in the different age levels determined need to be learned. These standards allow the educational system to use the content of astrophysics and astronomy to improve the conception and learning of the students.
One of the other countries in this comparative study for astronomy education is the United Kingdom. The Curriculum of the school pays attention to the students' expertise so at the first per subject there are some activities for training of experts, knowledge and conception for the use of science and then these experts and this awareness is articulated in separate content. There are also universities in Australia who specialise in these fields and one provides graduate students (PhD) for places at NASA.

Turkey is one of the other chosen countries for this comparative study about Astronomy education. By educational re-organization in Turkey in 2005-2006, the Intermediate level of education increased from three years to four. In this framework intermediate level is related to 14-17 years old students. The goals of intermediate level in Turkey are "to present the public culture to the students, to make the students familiar with the individual and societal problems. Problem solving education, increases their awareness for promoting participation in the socio-cultural development in the country, prepare students for higher and expert education and their life and business according to their interests and experts."

China is the other member of this comparative study. The knowledge of astronomy has a rapid development in this country since 1977. thus in this country mass media like radio and television uses like heavens showers since the knowledge of astronomy to be known and famous. Astronomy present as physics and Geography in Chinese high schools. In the last year of high school a subject like the knowledge of the earth and the sky combined in Geography.

Our comparative study has anther members in the name of Malaysia. There is no separate lesson as Astronomy in this country's curriculum most of this educational content is presented in Physics. Of course Geography does feature it in its Curriculum too. Of course in Malaysian schools Curriculum Quality is more important than quantity.

Indian educational system does not have a special curriculum for Astronomy education. Astronomical subjects present in physics at grade 11 and 12 at high school too in order to create a suitable conception about the nature and material. Specifically some lessons in Astronomical education have been presented in Physics books of grade 11 at high school.

Since in the school of our country there is no effort to present Astronomy education. Astronomy curriculum education is limitedly present at secondary school. Most of the teachers are employed in one of the main branch of natural sciences so they are not able to teach the subjects of Astronomy curriculum (Shekarbaghani, 2014, Casey & Slater, 2003).

Ahmadi (2011) did a survey of science, physics, geography, geology and mathematic according to the general and

intermediate level and provided a suitable framework. Astronomy education for general and intermediate level according to Iranian culture has been surveyed in this research. Then a suitable framework according to the educational level has been created. We can use it for examining the structure and organizing the content of Astronomy education. It provides, as such an answer to one of the questions of the present research.

In the past few years, the Philippines have been gradually developing their research and educational capabilities in astronomy and astrophysics. In terms of astronomy development, it is still lagging behind several neighboring Southeast Asian countries such as Indonesia, Thailand and Malaysia, while it is advanced with respect to several others. One of the main issues hampering progress is the scarcity of trained professional Filipino astronomers, as well as long-term visions for astronomy development. Here, we will be presenting an overview of astronomy education and research in the country. We will discuss the history and current status of astronomy in the Philippines, including all levels of education, outreach and awareness activities, as well as potential areas for research and collaborations. We also discuss issues that need to be addressed to ensure sustainable astronomy development in the Philippines. Finally, we discuss several ongoing and future programs aimed at promoting astronomy research and education. In essence, the work is a precursor of a possible white paper which we envision to submit to the Department of Science and Technology (DOST) in the near future, with which we aim to further convince the authorities of the importance of astrophysics. With the support of the International Astronomical Union (IAU), this may eventually lead to the creation of a separate astronomy agency in the Philippines (Sese, et al, 2015).

The past several years have presented the astronomy education research community with a host of foundational research dissertations in the teaching and learning of astronomy. These PhD candidates have been studying the impact of instructional innovations on student learning and systematically validating astronomy learning assessment instruments (Slater, 2008).

For over 40 years, the international astronomy education community has given its attention to cataloging the substantial body of “misconceptions” in individual’s thinking about astronomy, and to addressing the consequences of those misconceptions in the science classroom. Despite the tremendous amount of effort given to researching and disseminating information related to misconceptions, and the development of a theory of conceptual change to mitigate misconceptions, progress continues to be less than satisfying. An analysis of the literature and our own research has motivated the CAPER Center for Astronomy & Physics Education Research to advance a new model that is allowing us to operate on students’ astronomical learning difficulties in a more fruitful manner. Previously, much of the field’s work discarded erroneous student thinking into a single construct, and from that basis, curriculum developers and instructors addressed student misconceptions with a single instructional strategy. In contrast this model suggests that “misconceptions” are a mixture of at least four learning barriers: incorrect factual information, inappropriately applied mental algorithms (e.g., phenomenological primitives), insufficient cognitive structures (e.g., spatial reasoning), and affective/emotional difficulties. Each of these types of barriers should be addressed with an appropriately designed instructional strategy. Initial applications of this model to learning problems in astronomy and the space sciences have been fruitful, suggesting that an effort towards categorizing persistent learning difficulties in astronomy beyond the level of “misconceptions” may allow our community to craft tailored and more effective learning experiences for our students and the general public (Slater et al,2015).

Research Questions

According to the mentioned goals the mentioned plan would answer the following questions:
1) What are the goals of astronomy education affecting everyday life?
2) What is the total guidance of the Astronomy education affecting everyday life?

Research Method

Documentary method has been used for data gathering in the present research. Particularly, superior finished reports of projects, papers, books, thesis, international documents and plans have been used in this research.

Some of the used resources are as follows:
• English and Persian books about the curriculation and education of Astronomy. Data sites about education and curriculum of Astronomy.
• Informational sites about the curriculum and education of Astronomy is needed.
• Educational books of schools about Astronomy measuring
• Superior documents include the fundamental evolution documentary of education in the Islamic Republic of Iran (IRI) and national educational curriculum of IRI.
• National reports of universal reports in curriculum and education of Astronomy
• The results of four finished research studies with the below contents(which in fact the present research is related to them):
1. Feasibility measuring of Astronomy education founded on the Islamic culture and civilization in general and intermediate educational level.
2. The comparative study of Astronomy education for Islamic republic and the goals countries require.
3. The survey and reinvestigation of the educational books like science, geography, geology and mathematics in the light of the education of Astronomy and to present the appropriate framework.Survey the evolutional process of Astronomy education from Dar ul-Funun that has been studied up to now. We have the expert’s opinion about the elements of Astronomy education and still require guidance for astronomy education. In fact the questions of

the research have been answered by description, analysis and interpretation of the named documentation. The prepared educational guidance for the education of Astronomy has been validated by the questionnaire which is filled out by the teachers of physics and the other various lessons which are related to Astronomy (Shekarbaghani: 2014).

The Guidance of the Curriculum and education of Astronomy framework

The framework of the Astronomy curriculum for intermediate level includes the books which are obtained from the literature of the research. This framework shows the theoretical elements of curriculum. Its framework shows the general directions of curriculum for astronomy and it is a source for guidance, preparation and preparing the curriculum of Astronomy for intermediate levels. Teaching plan and educational designation for education of Astronomy has been prepared according to Islamic culture and civilization. We will present a sample of designated lessons of astronomy. Also we prepared this issue based on the Islamic culture and civilization and it is related to the concepts of the geography book of the first grade of the intermediate course.

The name of the lesson: **Astronomy**
Lesson: Geography
Educational concepts: "Qiblah" (direction to which Mohammedans turn in praying) and "Qiblah" finding
The goals of lesson:
Pay attention to the sky and investigating in it at night
How to looks at the sky and register your observations?
Pay attention to shining direction of the sun for "Qiblah" finding.
Teaching time: 100 minutes during a sunny day (teaching expert 20': learning activities 50', assignment, asking and answering questions 10' minutes, evaluating 10').
Addressees: The students of grade one in intermediate level, girls/boys.
Activity format: Individual and collective (students divide to different groups with five members and start their activity. A group will inform the students who are interested in individual activities).Initiation of teaching skills (laying the groundwork and establish the learning situation): ´This skill begins with questioning and answering. Teacher asks his/her students about the class about the "Qiblah" situations in different locations, and then provides a conclusion for these answers. After that the student should be driven to he school courtyard and by doing collective and individual activities learn how to place the "Qiblah" direction.

The validation of the curriculation of Astronomy Guidance
Researcher built questionnaire (consists of thirteen closed questions) has been used for validation of the gained elements. Realities of this questionnaire confirmed by content validation which is done by the subjective experts consulting group.

At first a brief quality of surveyed elements which are needed to be assembled as the suggested curriculum of astronomy would be sent to the selected teachers (before they answer the questions, for their familiarity with the elements of the suggested curriculum). In fact we tried to account for the validation of these elements via this.

Then we asked them to study the curriculum carefully and after that to answer the questions. For doing this we gave out 50 questionnaires to 50 teachers.

We gathered all 50 questionnaires. Thus the final version prepared by the teachers' answers to the questions (by using the analytical method for the presented answers according to the guidance of curriculum). For surveying the reliability of the questions we use Cronbach coefficient equal to 0.708.

Briefly the general curriculum of astronomy had been prepared by this way:
1. To understand the theoretical fundamental and conceptual framework of the astronomy curriculum attitudes and the universal experiences for the education of Astronomy.
2. Gathering the needed data in the area of the guidance of the curriculum of Astronomy and to study the previous plans which have been done in IRI.
3. Adding up the field data and to survey prerequisites for preparing the general curriculum for education of astronomy and to survey the upper documents like the document of national curriculum of natural sciences which includes Astronomy; and to answer the questions of the research for assigning philosophy, goals and attitudes of Astronomy education.
4. Assigning the offering arguments for entrance of the Astronomical subjects in educational books.
5. Survey of primary plan for the guidance of the curriculum of Astronomy and gaining the deliberative views of the subjective experts
6. To present suggested guidance of the curriculum of Astronomy for secondary schools.

Finding the validity of suggested guidance for the curriculum of Astronomy and at last the founding of the research and the final results presented.

Discussion and Results

This study has been done to help the experts and staff of curriculum and the others to practically think about Astronomy education affecting everyday life. So they need to make some changes in books and create an appropriate curriculum and train expert teachers, prepare a suite of instruments and library for this subject and finally conduct these lessons at schools. So the suggested elements of guidance for Astronomy in general education using the results of this research are briefly present below:

• Desired attitude of general guidance curriculum for astronomy education:

A composing from monotheism naturism along with cognitive development attitude, the attitude of Curriculum as technology and development of self-dehiscence are suggested.

• General and minor goal followed by training school with respect to desired attitude:

Consists of creation of scientific spirit and interest to research for students, study and survey of Astronomical phenomena in human daily life, study and understanding of social facts in different areas and scientific understanding of Astronomical phenomena, thoughts, habits, opinions, tendencies, rituals, values and traditions with respect to element, criteria, combatting superstitions, imagination.

• The general goals of Astronomy education in our country are to know the surrounding phenomena like moon circling around the earth, earth circling around the sun, appurtenance.

• The particular goals of Astronomy education to the students of Islamic Republic of Iran (IRI) concludes some religious lawful facts like rising of the sun, sunset and lunar month for social and cultural evidence.

• The content structure of Astronomy curriculum in appropriate attitude:

This structure according on a deductive and inductive basis and comparative attitude in curriculum books most common like geography, history, social science, mathematics, geometry, physics, geology, and continued presentation of Astronomy at educational duration, the students' ages, and with an interdisciplinary method is suggested.

• Educational method for Astronomy education at first and second intermediate durations:

This curriculum should have the teachers create educational presentations and doing evaluation of curriculum in the class and planning for scientific and practical development for the students. The teaching of Astronomy has not only been based on information presentation, since this lesson can help the students in learning and researching. The teacher has to create a suitable environment for students' abilities and talents. Teacher causes the communications to be facilitated inter human and communication with their environments and promote this.

• Exploration methods for the subjects of Astronomy at first and second intermediate durations:

This method has continually been done to be an opportunity for the students 'situation and also prepare a suitable environment for their ability improvements. Presentation of the exercises should be proportionate to their mental ability. The Exploration should accompany the usage of instruments of leading technology.

• Educational technologies for the education of Astronomy for intermediate course:

Such technologies includes the use of the existing sky maps for night and day, the use of photography and film using Skye, use of computers and computer imagery, to use cameras and various kinds of telescopes in the planetariums and to visit the observatories. Through performing spatial phenomena, the students of the intermediate course gain the opportunity to survey ina good atmosphere and watch the interesting astronomical phenomena which is performed outside. By internet and communication with various sites especially with NASA we can directly connect to Hubble telescope and survey Sky phenomena on the earth.

Of course the purpose of paying attention to Astronomy is not monopolistic to the use of telescopes! There are many landscapes in the night sky which the students can access by going to their house yard and looking at them in sky. The numbers of these landscapes are even more than what we consider. It is correct that a telescope or binocular camera is a useful instrument yet for education of Astronomy and to be familiar with the beauties of sky their acquisition is not necessary.

• One of the other results of this research is the teachers' lack of interest or knowledge in Astronomy education. Conception of the knowledge content is very important to teaching the curriculum of astronomy. Although it may be found that what you learn today is not applicable for the next year.

Thus, and the more importantly the teachers have to know how to prepare themselves for teaching Astronomy which consist of contextual and skills knowledge. The teachers of the connected lessons to Astronomy such as mathematics, physics, geometry, geology, and geography and history are part of astronomy education and should be included in training classes.

Although the study of astronomy has provided a wealth of tangible, monetary and technological gains, perhaps the most important aspect of astronomy is not one of economical measure. Astronomy has and continues to revolutionize our thinking on a worldwide scale. In the past, astronomy has been used to measure time, mark the seasons, and navigate the vast oceans. As one of the oldest sciences astronomy is part of every culture's history and roots. It inspires us with beautiful images and promises answers to the big questions. It acts as a window into the immense size and complexity of space, putting Earth into perspective and promoting global citizenship and pride in our home planet.

On a more pressing level, astronomy helps us study how to prolong the survival of our species. For example, it is critical to study the Sun's influence on Earth's climate and how it will affect weather, water levels etc. Only the study of the Sun and other stars can help us to understand these processes in their entirety. In addition, mapping the movement of all the objects in our Solar System, allows us to predict the potential threats to our planet from space.

On a personal level, teaching astronomy to our youth is also of great value. It has been proven that pupils who engage in astronomy-related educational activities at a

at a primary or secondary school are more likely to pursue careers in science and technology, and to keep up to date with scientific discoveries (National Research Council, 1991). This does not just benefit the field of astronomy, but reaches across other scientific disciplines.

References

1. Ahmadi, A. (2011). The survey of the curriculum of books like science, physics, geography, geology and mathematics according to Astronomy education and present suitable frame work, full research reports, research and curriculum organization Tehran.
2. Alvandi, H. (2010). The evolution route of Astronomy education in Iran from Dar al Fonon up to now full research reports, research and curriculum organization Tehran.
3. Aitken, R.G. (1933). The Use of Astronomy. Astronomical Society of the Pacific. Leaflet 59, December 1933, 33¬36.
4. Bode, Cruz & Molster. (2008). The ASTRONET Infrastructure Roadmap: A Strategic Plan for European Astronomy, http://www.eso.org/public/archives/books/pdfsm/book_0045.pdf, August 2013.
5. Casey, T. L. and Slater, T. F. (2003). A Comparison of Group and Individually Completed Course Evaluations in Introductory Astronomy, the Astronomy Education Review, 2(1) 1-4.
6. Finley, D., Value of Radio Astronomy. http://www.nrao.edu/index.php/learn/radioastronomy/radioastronomyvalue,. Retrieved November 2013.
7. International Astronomical Union. (2012). IAU Astronomy for Development Strategic Plan 2010–2012.http://www.iau.org/static/education/strategicplan_2010-2020.pdf, June 2013.
8. Krumenaker, L. (2009). The Modern U.S. High School Astronomy Course, Its Status and Makeup, in the Era of No Child Left Behind. Astronomy Education Review, 8, 1, (December).
9. National Research Council. (1991). Working Papers: Astronomy and Astrophysics Panel Reports, Washington, DC: The National Academies Press
10. National Research Council. (2010). New Worlds, New Horizons in Astronomy and Astrophysics. Washington, DC: The National Academies Press.
11. Renée James, C. (2012). What has astronomy done for you lately?, www.astronomy.com, May 2012,30-35
12. Sese, R. M. D.; Kouwenhoven, M. B. N. Thijs. (2015). Developing Astronomy Research and Education in the Philippines. Science.gov (United States).
13. Shekarbaghani, A. (2014). The survey and Explanation of the total curriculum of astronomy education in the curriculum of various educational level, full research reports, Educational research Studies, Tehran.
14. Shekarbaghani, A. (2010). The comparative study of Astronomy education in Iran and the others countries, research and curriculum organization Tehran.
15. Shekarbaghani, A.; Badrian, A.; RastegarNasab, G. (2008). Feasibility of Astronomy Education According to Islamic Culture and Civilization for general and inter Mediate courses, Full Research report, research and curriculum organization Tehran.
16. Slater, Timothy F.; Slater, Stephanie J. (2015). Refocusing International Astronomy Education Research Using a Cognitive Focus Science. Gov (United States).
17. Slater, Timothy F. (2008.) The First Big Wave of Astronomy Education Research Dissertations and Some Directions for Future Research Efforts. Science.gov (United States).
18. Truman, H. (1949). Inaugural Presidential Speech, http://www.trumanlibrary.org/whistlestop/50yr_archive/inagural20jan1949.htm, June 2013.
19. Zühtü Okulu, H.; OĞuz-Ünver, A. (2009). Determination of the teacher candidates' Attitudes towards astronomy ISSN 1308 – 8971 Special Issue: Selected papers presented at WCNTSE Western Anatolia Journal of Educational Sciences (WAJES), DokuzEylul University Institute, Izmir, Turkey ISSN 1308-8971 107.