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Faces on Mars Lesson: Incorporating Art, Thinking Skills, and Disability Differentiation Strategies for Twice-Exceptional Gifted Students

Marine Pepanyan, Mike Fisher, and Audrey Wallican-Green

University of Northern Iowa

Abstract

This practical article provides an example art-integrated lesson designed to serve gifted students with the exceptionalities of deficits in executive functioning and in impulse control. The lesson used the mysterious science problem of possible life on Mars as evidenced by anomalous faces in NASA photographs as a stimulus for practice in processing information through three Edward de Bono CoRT Thinking Skills. This lesson demonstrated differentiating instruction for gifted students with disabilities that included hands-on and peer-involved exercises. Examples of student work showing comic book-like stories about the famous Face on Mars are included, along with student responses to the thinking skill activities.

Key Words

De Bono CoRT thinking skills, executive functioning, impulse control, twice exceptional gifted, differentiation, arts integration.

Introduction

"High ability learners, also known as gifted students, demonstrate superior performance or talents in any number of intelligences, whereas students who are twice-exceptional demonstrate giftedness in one or more areas in addition to a diagnosed learning challenge" (Waugh, 2016, p. 23). Gifted students with learning challenges need to be encouraged through activities that include creativity, problem-solving, and critical thinking skills (Waugh, 2016). Growth for gifted students may be observed when the curriculum is flexible, and when the environment allows for self-expression, collaboration or group discussions, hands-on activities, self-evaluation, and inquiry-based activities (Waugh, 2016). The purpose of this practical article is to present a lesson specially-designed to accommodate, and at the same time, challenge gifted students with two areas of exceptionalities: executive functioning and impulse control. The lesson explores anomalies in National Aeronautics and Space Administration (NASA) photographs of the surface of Mars (the "Face" on Mars) using inquiry. The lesson incorporates inductive reasoning for students to explore the Mars Mystery through three de Bono (1985) CoRT Thinking skills: First Important Priorities (FIP); Aims, Goals, and Objectives (AGO); and Contradictions. Participants of the practical lesson were adult high-achieving doctoral students, many of whom had been identified as gifted and talented during their K-12 schooling. Although none of the participants were identified as students with disabilities, it doesn't mean they had none. In gifted students, the outstanding ability or talent in one area may often hide and/or compensate the exceptionality, making identification of twice exceptional students more challenging (Hernández Finch, Speirs Neumeister, Burney, & Cook, 2014).

The current lesson could be adjusted to different age groups by school educators.

Literature Review

This literature review introduces the history of one of the great modern mysteries of humanity, "The Face on Mars," to provide important background on this Martian feature. A brief literature review of each of the two disabilities addressed by this lesson is also provided. The crucial skills of executive functioning are discussed first, while the importance of impulse control is addressed in the third section of the literature review.

Mars Mystery: The Face on Mars

Four decades ago, in 1976, NASA's Viking 1 and Viking 2 ships spotted a shadowy likeness of a human face on the surface of Mars (Philips, 2001). For some years, this face was known as an alien monument. The cameras photographed the "Face on Mars" in the region called Cydonia. See Figure 1.

When, in 1998, Michael Malin and his Mars Orbiter Camera (MOC) team snapped a picture which was more precise and ten times sharper, the myth of the "Face" became sandy, because the image revealed a natural landform. See Figure 2. Malin's team captured a photograph (with the camera's absolute resolution) actually showing Mars's equivalence of a mesa, a flat-toped elevated desert landform common in western United States. Three-dimensional elevation maps revealed the formation from different angles providing no chance for lights and shadow alternation. Planetary geologists showed great interest in the mesas of Cydonia. They suggested that Cydonia might have several free-standing eroded landforms.

Dunning (2008) similarly stated that after some decades new cameras took more focused images, culminating in the 2001 image taken by the Mars Global Surveyor, with an even greater resolution. The Cydonia "face" appeared to be merely an unremarkable hill with plenty of natural random variations on its surface. This "face" no longer looked anything remotely like a face or any other kind of carving. The improved image showed that it was nowhere near as symmetric as it appeared to be in the original blurry image.

Those believing this anomaly is just a natural, eroded landform explained that geological features that happen to look like faces, people, or other objects are not rare. For instance, in Alberta Canada, there is a figure called the "Badlands Guardian" that, when viewed from the air, looks astonishingly like a Native American wearing a full headdress. See Figure 2. The Badlands Guardian appears more like a person than the Cydonia face ever did (Dunning, 2008, para.5).

Dunning (2008) explained that the human brain has such perceptual phenomenon as pareidolia which means seeing patterns in random data. This phenomenon provides loose parameters to decide what qualifies as a face. The human brain may still identify a face even if it's as indistinct as the Cydonia face. To support this phenomenon, Zimmerman (2012) describes pareidolia as a psychological phenomenon that causes some people to see or hear a vague or random image or sound as something significant. She also wrote about "The face" on Mars as an example of people thinking about ancient civilization on that planet. To question why pareidolia happens, Zimmerman (2012) explained that there are a number of theories behind that, such as "pareidolia provides a psychological determination for many delusions that involve the senses.

Another point of view concerning the Face on Mars originated with Richard C. Hoagland and Mike Bara (2007). These researchers noted that the 2001 Mars Orbiter Camera image was unusually low-contrast, noisy, and washed-out because it was not taken from an overhead position, but some time after the spacecraft had passed the monument. "Details of the right side, previously shadowed in the Viking images, were visually compressed by perspective and hidden behind the 'nose.'" … "The image was so lacking in contrast and detail that it gave the impression of a flat, blank, desert landscape, with virtually no elevation at all" (Hoagland & Bara, 2007, p. 290-291). Additionally, evidence that only half of the available data had been used in the image, the reduction of 256 gray shades to only 42, and image processing through a high-pass filter by NASA, which obscures details and contrast even more, caused the "high-resolution" image to be very poor. After the evidence that only half of the data had been used in

the image was made public, NASA revised the caption on the photograph to reflect the lower resolution, admitting the "error" as a typographical problem. These observations lead to questions of whether the 2001 face is a true representation of what exists on Mars.

A fascinating aspect of the Face on Mars mystery is the fact that Jack Kirby, an American comic book artist, writer and editor, years before NASA's Viking 1 and Viking 2 spaceships' discovery, created and sketched a comic book story titled, "The Face on Mars" (Kirby, 1958; Mendryk, 2012). The Comic Code Authority approval stamp is dated December 18, 1957. The approval stamp was only applied to finished art ready for publication, which means that date was the latest the original art could have been created. Thus the cartoon was drawn prior to NASA's Mars Viking photographs.

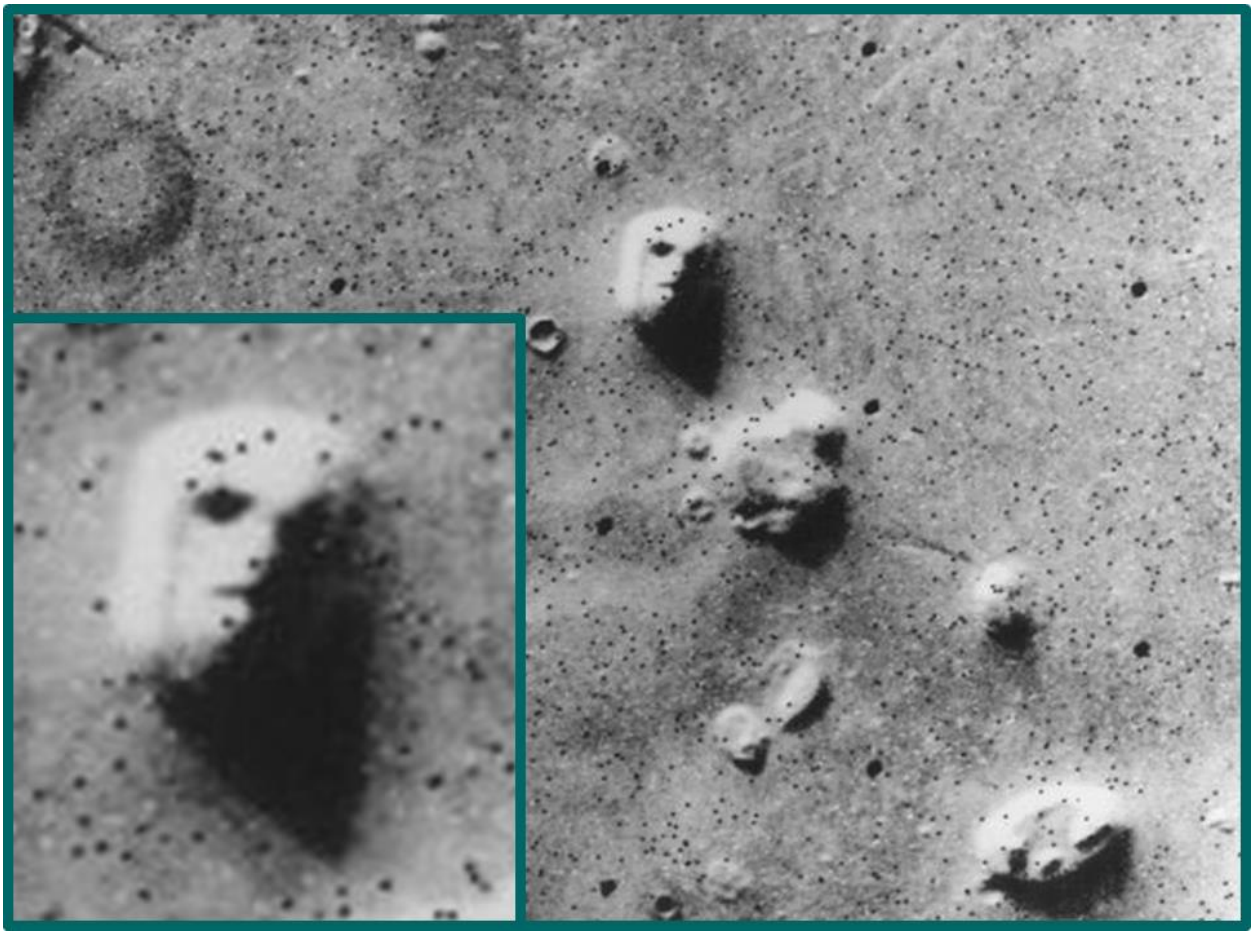

Figure 1. Famous Face on Mars photographed in 1976 by Viking Obiter 1 from a distance of over a thousand miles. Image Courtesy NASA/JPL-Caltech (JPL & NASA, 1998)

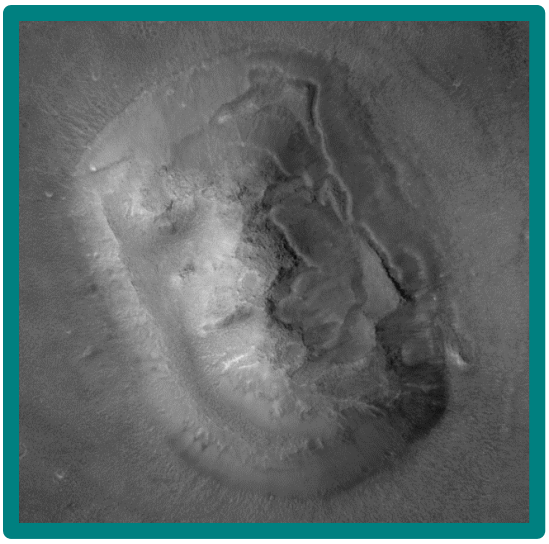

Figure 2. Another photograph of the Face on Mars taken by the Mars Orbital Camera in 2001. This image does not show the human-like features the previous Viking photographs revealed. (NASA/JPL/Malin Space Science Systems, 2001) Image Courtesy of NASA/ JPL/ Malin Space Science Systems.

Figure 3. Google Maps image of Badlands Guardian from Cypress County, Alberta, Canada at 50°00'36.2"N 110°06'50.9"W. Image courtesy of Google Maps.

Gifted Learners with Poor Executive Functioning

Executive functioning can be described as the self-regulation skills that help organize information and provide critical supports for learning and development (Center on the Developing Child at Harvard University, 2014; Hernández Finch, et al., 2014). Executive functioning is characterized by three primary components within the development of the child: working memory, inhibitory control, and cognitive flexibility (Center on the Developing Child at Harvard University, 2014; Fuhs , Nesbitt, Farran, & Dong, 2014). The skills that are developed are what assists children to remember information, sort tasks, resist impulses, and sustain attention through activities. While humans are not born with these traits or skills completely developed, they are able to improve them through the human growth process (Center on the Developing Child at Harvard University, 2014; Gathercole, Pickering, Ambridge, & Wearing, 2004). Research has indicated there are multiple developmentally appropriate exercises to build executive functioning skills (Center on the Developing Child at Harvard University, 2014). This includes games (Rueda, Rothbart, McCandliss, Saccomanno, & Posner, 2005), role play, songs, conversations, storytelling, physical activities (Hillman, Pontifex, Raine, Castelli, Hall, & Kramer, 2009), and imagination (Center on the Developing Child at Harvard University, 2014). These are all based upon the developmental need of the child in the child's progression of growth.

Students who have demonstrated a deficit in executive function development have found success through targeted strategies by educators and parents to accommodate and close the performance gap (Axelrod, Barnes, Baum, Burke, BurnColucci, … & Castronova, 2012). Using a variety of differentiated resources and activities, the cognitive processes in the areas of organization of thoughts, decision making, task prioritization, and time management can be improved when a child performs significantly lower than peers (Axelrod et al., 2012). Some differentiation techniques for these deficits include addressing sustained attention, working memory, inhibition, thought and/or task organization and emotional control (Axelrod et al., 2012).

The strategies that were integrated into the lesson presented in this article included strategies that assisted with decision making through graphic organizers and time management with structured sequences of components. It also included chunks of instruction to assist with sustaining attention and improved inhibition control.

Gifted Learners with Poor Impulse Control

Impulse control disorders may be labeled as substance usage disorders, skin picking, or as attention deficit disorders. In children, lack of impulse control may manifest as silly or inappropriate attention-seeking behavior, difficulty following rules, impatience in waiting for a turn, grabbing toys, food or items from others, shoplifting or stealing, overreaction to frustration, desire to always have the first turn and the last word, and inability to understand consequences of own actions and the effects on others (Morin, 2017). These impulse control disorders often lead to adult disorders including sexual disorders, gambling, compulsion with shopping, and a vast number of other disorders which are repetitive and compulsive. The disorders are defined as failure to resist an impulse which might lead to causing harm. The disorders may be a result of self-satisfaction or they may fulfill the need of pleasing oneself (Morin, 2017).

Impulse Control Disorders begin in adolescence and is often found in youth who also have other psychiatric disorders. If the disorders are not redirected in these youth, they often become adults with drug or mood disorders. Children often don't realize they are acting in an inappropriate way. Educators working with children may identify the correct way of behaving or "catch" the child in appropriate behavior to help draw the child's attention to the issue.

Educators need to pursue a holistic approach to provide instruction for children with Impulse Control Disorders (Morin, 2017). Children are best-educated when teachers implement differentiated instruction, providing students with hands-on activities, manipulatives, and use of technology, visuals, and other interactive strategies that benefit children with these disorders. Using images, music and role-play are also ways to meet the needs of these diverse learners. When assessing these students, authentic assessments and other attention grabbing strategies must be used.

The lesson presented here implemented some of these best practices for students with impulse control deficits by providing differentiated approaches, hands-on activities, manipulatives, and visual technology. The approaches provided the structure and differentiation needed to best accommodate learners with exceptional needs around executive functioning. These approaches provides multiple methods for students to access the content.

The Lesson

The presented lesson used an inquiry approach facilitated with thinking skills and targeted strategies that addressed exceptionalities in executive functioning and impulse control. The lesson approached the content of the "Faces of Mars" as a mystery to be addressed. Graphic organizers were built into the lesson to accommodate the two disabilities. Arts-integrated projects help provide additional challenge that gifted students need (Gadanidis, Hughes, Cordy, 2011). The same study also found that an arts integrated project helped the students engage with academic content on a deeper level while also increasing the level of concentration of the students. In the current study, the arts-integrated project included creating a cartoon/comic strip.

Participants

Twenty-three adult participants (17 White, 4 Black, 2 Asian; 15 male, 9 female) with a mean age of 39 years were engaged with the lesson activities. These participants were high-achieving doctoral students, many of whom were identified as gifted and talented during their k-12 schooling. Therefore, this sample did simulate a gifted group. Data on disabilities were not collected, although it is likely that some had experienced impulse control or executive functioning difficulties in the past or present.

Lesson Procedures and Strategies Utilized

Learning intentions and success criteria. A clear learning intention was stated to make the targeted outcome known to the student. The posted learning goal stated, "Student(s) will be able to use three de Bono thinking skills and demonstrate the ability to transfer knowledge in a creative manner." The primary learning outcome for students was to actively utilize three unique de Bono learning goals to expand the depth and scope of learning through an inquiry approach. In addition, posted success criteria were utilized. These success criteria were the components of the lessons that allowed students to further break down hinge points within the

lesson and their learning to reflect if they had achieved success. The success criteria are listed below:

- Students will demonstrate competency of using First Important Priorities through review of the success criteria.
- Students will demonstrate competency of using Contradictions in a peer review discourse conversation.
- Students will demonstrate using of Aims, Goals, and Objectives in a collaborative summarization to peers and class.

Launch. The three components of the lesson each infused a different de Bono thinking skill into the instruction. The lesson began with a "launch," a short component in which the problem is presented to the class. Strategies are not presented; rather, the problem is concisely shared with the class. Capitalizing on the curiosity gap generated by the intriguing image, and then organizing student thoughts through the "Aims, Goals, and Objectives" de Bono thinking skill, the students were primed for the next section of the lesson.

The procedures for the Launch component follow. Teachers conducted a 15 minute launch and presented the Mars Mystery of Faces through images of the famous Face on Mars. The class was presented with the official NASA story for the Mars anomalies. The class was challenged to create a cartoon that provides an alternate theory to why the faces exist. Students used an Aims, Goals, and Objectives template to organize their thinking about reasons for exploring the Face on Mars before beginning the cartoon. Students were then provided with a comic book-style cartoon template and colored pencils.

Explore. In the next component known as the "explore", students were given time to individually and then collaboratively in small groups discover strategies to solve the presented problem. In this portion of the lesson, students were each given time to individually develop an explanation for the presented Mars Mystery and then present it to the group. Students had three minutes per person to explain and debate with their groups on why each member believe that his or her cartoon and reason was the most plausible explanation. The small groups debated for five minutes which cartoon in the group was most plausible using the de Bono thinking skill of "Contradiction."

Summarization. In the final component of the lesson called, "summarization," the groups used a graphic organizer to organize their work regarding the "First Important Priorities" de Bono thinking skill. This graphic organizer allowed the small group to select one cartoon members agreed was the most plausible. Students had five minutes to prioritize the explanations given in their group from most plausible to least. Finally, each group presented the selected cartoon to the class as a whole. A group representative came to the board and posted the selected cartoon with tape. Each representative had 1 minute to explain the cartoon to the class. The entire class voted via a gallery walk to determine the final "most plausible" solution to the Mars Mystery problem. Each student was given a sticker to place upon the cartoon that he or she thought was most plausible.

Differentiation. The lesson focused on two differentiation techniques for exceptional learners: To accommodate learners with executive function difficulties, graphic organizers and cartoon templates were provided to better focus thinking. The lesson also provided scripted components with structure. The lesson was designed with hands-on and peer-involved exercises to provide students needing times of tactile and social involvement to facilitate impulse control.

Assessment. All cartoons and graphic organizers were collected. The response data from the thinking skill exercises was categorized to determine the most frequent types of responses, the breadth of student thinking and achievement of learning intentions.

Results and Discussion

The goal of the lesson was to observe how well the students applied three of Edward de Bono's (1985) CoRT thinking skills, as well as how well they are able to transfer to the novel ability of inquiry based collaborative learning. This section presents the results of the analysis and discussion of the collected data (artifacts, responses to thinking skills, and group debates).

Aims, Goals, and Objectives (AGO)

According to de Bono's (1985) CoRT Breadth Thinking Skills explanation of AGO, an *aim* refers to the general direction of a project or action; a *goal* defines the final destination; and an objective is a recognizable point of achievement. The task of the students was to determine the aims, goals, and objectives that related to their project of determining reasons for exploring the Face on Mars.

Table 1 shows the results of analysis of student responses to the Aims, Goals, and Objectives thinking skill. The most frequently given reason for exploring the Mars face was through empirical evidence to determine its origin. The second-most-frequent response was to discuss people's beliefs about the phenomenon. For instance, the students explained that the aim was "To determine or explore so many possibilities for the appearances of the faces", or "I want an explanation as to what the object is", or "To explain the picture so people don't freak out". The third-most-frequent responses formed the category of other plausible alternatives to NASA's explanation. The participants mentioned "previous life on Mars created this faces" or "it could be due to the camera effect and might be people want to see it this way" (beliefs); "An ancient Mars civilization wanted to commemorate a leader" or "to identify different options or possibilities that it can be something else" to serve as an alternative explanation to the mystery, etc. The answers of participants illustrated multiple viewpoints or ways of considering the problem, thus confirming that de Bono skills broaden perceptions of students.

Table 1. *Results for de Bono Thinking Skill of "Aims, Goals, Objectives"*

Categories	Frequency
Empirical evidence	31
People's beliefs about the phenomenon	13
Alternative possibilities /other explanations	11
Authenticity of the phenomenon	3
Looking for similarities	1

Contradictions

To make a decision concerning whose cartoon story was the most plausible, the participants used de Bono's (1985) thinking skill of "Contradiction." There are several ways to view statements of information about the cartoon explanation of origin of the Face on Mars. Information may be incorrect, thereby making conclusions false, making it important to identify false conclusions. Sometimes pieces of information contradict each other. In this de Bono thinking skill, students identified contradictions and false conclusions in cartoon statements about the Face on Mars.

Table 2 illustrates the results of students' responses (Conclusions and False Conclusions) after they viewed the cartoons and explanations developed by peers in their groups. For most of the participants, three aspects of the cartoons and explanations were referred to most frequently: the cartoon presented a realistic scenario and convincing drawing; the cartoon contained creative elements; and the cartoon contained alternative explanations. Also, the information in the cartoon needed to be easy to understand in order to disseminate the Mars mystery to a large mass of public.

In the search for some information, students sometimes may make false conclusions and incorrect uses of that information. The feedback on False Conclusions are the examples of how the same students looking at the same drawings decide on whether they are convincing, or not. Several students even inferred that there are no false conclusions at all.

Table 2. *Results for Contradictions using Edward de Bono's CoRT Thinking Skill*

Conclusion	Frequency
Realistic/convincing drawing	32
Creativity of the drawing	16
Alternative explanation	5
Making Mars accessible to general public	5
No conclusion	4
Drawing needs clarification	2
False conclusion	**Frequency**
Drawing needs more details to be convincing	41
Alternative explanations	15
No false conclusion	6
Least creative	2

First Important Priorities

The de Bono thinking skill of First Important Priorities (FIP) requires students to determine the factors or objectives or consequences involved and to prioritize them. During the activity in which this thinking skill was applied, each group of participants had one representative come to the board and post the group's selected cartoon. Each representative briefly explained the cartoon and strategy to the whole class. After presentations, the participants complete the "FIP" graphic organizer to determine the most plausible explanation of the drawing. With a provided sticker each participant voted on the cartoon they thought was most plausible based upon their FIP analysis. The results showed that by utilizing de Bono's thinking skills the participants gave more priority to realistic explanations and researched evidences contained in cartoons. Some students prioritized creativity and alternative hypotheses, though they were not in large number (see Table 3).

Table 3. *Results for First Important Priorities using Edward de Bono's CoRT Thinking Skill*

Categories	Frequency
Plausibility/realistic explanation	25
Researched evidence	21
Scientific discovery	9
Creative	6
Consensus	6
Alternative hypothesis	5
Practicality	3

Sample Cartoon Drawings

The choice of the most plausible cartoon was based on the activities which involved using de Bono's Breadth Thinking Skills. As is evidenced by the depictions, students had a variety of opinions about what the pictures show. Some agreed it might mean there's life on Mars others believed the pictures are simply photographs of rocks. Figure 4 presents several cartoon stories made by participants, showing a variety of themes.

Conclusion

In conventional education practices, only certain types of thinking are in demand: analytical, critical, and in continuum. Other types of thinking, for example, creative thinking, remain behind the scenes. Thinking is too often replaced by memorization of knowledge facts: why think, if you can just remember the right answer? The CoRT thinking skill system, created by Edward de Bono in the mid-1970s and included today in the programs of thousands of educational institutions around the world, was designed to fill these gaps in the traditional education system. Unlike the study of the content of our thinking, to which ordinary subjects are devoted, the CoRT thinking skill system focuses on the very process of thinking. The variations in students' feedback serve as examples of the broad range of perspectives generated through this approach. The essence of the CoRT method is that attention is deliberately directed to various aspects of thinking. These aspects can be guided through the use of graphic organizers. As a result, students develop the appropriate thinking skills, and the tools eventually come to the fore.

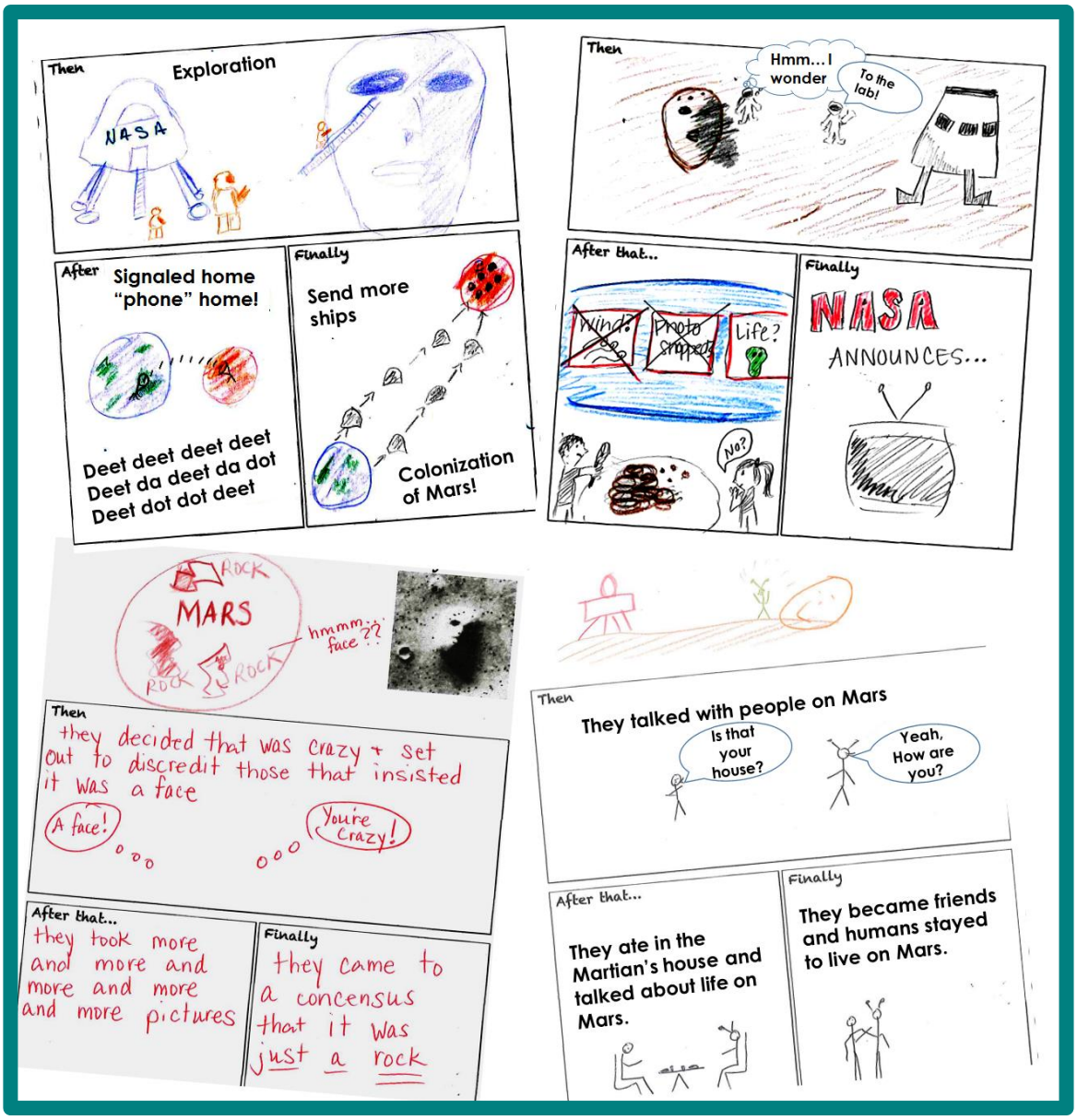

Figure 4. Example comic book-style stories created by students.

Through the lesson presented here, the authors accommodated such disabilities as Executive Function difficulties and poor Impulse Control. Students used a variety of graphic organizers and cartoon templates to better focus thinking to assist in executive functioning. Hands-on and peer involved exercises were aimed at satisfying the function of students needing times of tactile and social involvement for improved impulse control. The cartoon-creation visual arts project provided a fertile soil for practicing the de Bono thinking skills, creativity, and self-expression. It also provided an enticing component of art-making to the somewhat *dry* logical skills of First Important Priorities (FIP); Aims, Goals, and Objectives (AGO); and Contradictions.

Broadening perceptions through application of thinking skills, the designed lesson significantly expanded the possibilities of student thinking. This constructive and creative

dimension of thinking allow students to face the future. An implication of these skills is a teacher might look at students as humans having their own interests and goals instead of imposing one thought pattern upon them. This approach may help unfold intrapersonal and interpersonal talents within children with higher abilities.

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