MyStar
Summative Evaluation Summary Report
Space Science Institute

Submitted by:
Kirsten S. Büchner
Insight Evaluation Services
Fairfax, VA

July 2011

INTRODUCTION

The Space Science Institute (SSI) engaged Insight Evaluation Services (IES) to conduct a summative evaluation of an online, multi-user space science game called *MyStar*. The game, which was developed with funding from the National Aeronautics and Space Administration (NASA), was designed to introduce late middle school-early high school students to the basic concepts of stellar and planetary evolution. Specifically, as players continue to spend time with the game, they should discover the following:

- The galaxy has "habitable zones" where planetary formation and/or life is more likely;
- Stars are born and die, and their life cycle is controlled by their initial mass;
- The time scale for stellar evolution is on the order of billions of years;
- Solar systems have "habitable zones," inside which planets can support life;
- Life begins to form relatively quickly after the early "heavy bombardment" period, but takes billions of years to reach complex stages;
- Various events can interfere with the progress of life, including stellar encounters, asteroid impacts, and "gamma ray bursters."[1]

The evaluation was conducted to determine the effectiveness of *MyStar* in meeting its learning goals, in particular the first three listed above. To that end, IES identified a sample of 20 eighth grade students to play the game for a designated period of time and then participate in a telephone interview about their reactions to the game. The interview assessed students' opinions on the usability of *MyStar* (including their suggestions for ways to improve it), as well as what they learned from playing the game. In addition, students' actions were tracked during play in order to test the success of the game in actual use and to triangulate interview responses.

Game play began on May 24, 2011 and all log data were collected from that date through June 14, 2011 (the students' last day of school and therefore, the last official day of game play); interviews were conducted between June 2 and June 14, 2011. IES followed all Independent Review Board protocols to ensure that informed consent to participate in the study was obtained from students' parents/caregivers, as well as to ensure that students would remain anonymous at all times, including during the study period[2] and in any and all reports or publications that are prepared as a result. IES worked with the students' teacher to distribute/collect the permission forms, initiate game play, coordinate the telephone interviews and distribute small thank you gifts to the students at the end of the study; SSI was responsible for collecting students' log data. This report summarizes the results that were obtained.[3] Attached are the interview guide (Appendix A), consent form (Appendix B) and teacher instruction letter (Appendix C).

[1] Per the educator's guide at http://www.alienearths.org/mystar/educators/MyStar_The_Educators_Guide.pdf
[2] The study period was May 24-June 14, 2011.
[3] Unless otherwise noted, this report uses the following code to describe the percentage of responses from the sample: a few (20% or less), some (21%-40%), many (41%-60%), most (61%-80%), the majority (more than 80%).

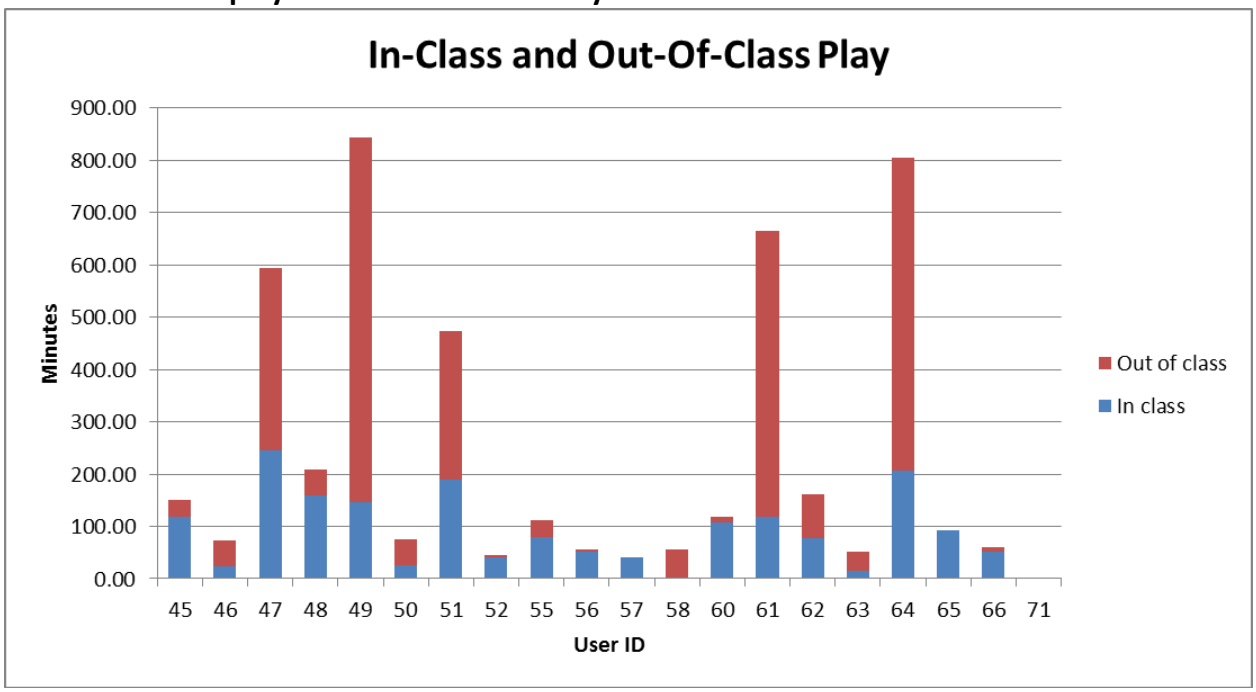
RESULTS

Characteristics of the sample

- The sample included 20 eighth grade astronomy students from a Washington, D.C. metro area magnet school.[4] Twelve of the students were male; eight of the students were female.

- All students played *MyStar* at school during their astronomy class, which met every other day; the teacher set aside approximately 20 minutes during each of the eight class meetings within the study period for the students to spend time with the game. The majority of students also played outside of class (i.e., at home or in another class where they had computer time, per interview data); only a few did not. Chart 1 below describes the total number of minutes within the study period that each student played, including in and out of class. In short, half of the students spent over 100 minutes playing the game, with half of those students playing more than 300 minutes.

Chart 1. Minutes played in and out of class by each student.



[4] In addition to the standard curriculum, students at the school receive instruction in such subjects like astronomy and engineering. Thus, the students in the sample had taken astronomy in sixth and seventh grade. The teacher noted that the students' current astronomy class was an elective "so there is a big range in interest, as well as socio-economic and ethnicity."

- Table 1 below shows the total active minutes, sessions and number of feats (out of a total of 17 feats) that students achieved within the study period.[5] With a few exceptions, it appears that the more time students spent playing the game, the more feats they achieved.[6]

Table 1. Time students spent playing *MyStar* and the number of feats they achieved.

Student	User ID	Active Minutes	Number of Sessions	Feats
19	71	3	1	1
17	57	40	6	1
8	52	45	11	1
12	63	52	7	3
13	58	55	7	1
16	56	55	12	2
18	66	60	9	1
1	46	73	20	1
2	50	74	41	1
14	65	92	7	2
7	55	111	21	3
15	60	119	26	1
5	45	150	35	8
20	62	161	22	2
10	48	209	25	6
9	51	474	68	9
11	47	594	58	10
3	61	664	195	15
4	64	804	121	13
6	49	843	150	13

[5] Readers of this report are reminded that while the study period was 22 days, a number of students started playing after the study period had begun and/or abandoned the game before the study period ended.

[6] Minutes and feats r=0.94, t-test=0.0003; sessions and feats r=0.90, t-test=0.0017.

- The average number of feats students achieved within the study period was five; the median was two. As Table 2 below shows, most students achieved three or less feats; only a few could be considered high achievers.

Table 2. Students (identified by their User IDs) as achievers of feats.

Student	User ID	Type of Achiever	Feats
1	71	Low	1
2	57		1
8	52		1
13	58		1
15	66		1
17	46		1
18	50		1
19	60		1
14	56		2
16	65		2
20	62		2
7	63		3
12	55		3
10	48	Medium	6
5	45		8
9	51		9
11	47		10
4	64	High	13
6	49		13
3	61		15

- When interviewed, most students spoke about what they had built in fairly general terms (e.g., "I made a couple of stars, like three stars, and that was pretty much it"); however, some were more specific, including several students who talked about what they built in terms of what it had cost them (e.g., "I built a 1,000 bux star and it was on the outside of the galaxy; I built another star that was a 300 bux star and it was closer to the middle").

  When asked about the feats they had achieved up to that point, many students again responded in general terms (e.g., "The first one when you turn on the game and then the second one to build a star" and "I'm still on Level One—that's what it says at the top of the screen") while a few students said "I don't remember"; the remainder could recall the feats by name (e.g., "'Star Bright,' 'Planeteer' and 'It has Potential'"). In addition, two students also mentioned the starbux they had earned/still needed to achieve more feats.

Students' opinions of *MyStar*[7]

- On a 7-point scale, where 1=very easy to figure out what to do and 7=not easy at all to figure out what to do, students rated *MyStar* 3.65 overall. As Table 3 below shows, many indicated they found it somewhat less easy to get started, assigning that aspect of the game a rating between 3 and 5.

Table 3. Students' ratings of how easy they found it to figure out what to do on *MyStar*.

Rating	1= very easy	2	3	4	5	6	7= not easy at all
Number of students who assigned that rating	1	4	5	4	3	3	0

- When asked what questions they had or what glitches they found, about one-third said that when they first got started "just didn't get it." One-fifth said they did not know how to get starbux; another fifth said they did not know how to create stars and/or planets. A few students each said they did not know how to get to the next level (three mentions), what to do while they waited either to earn more starbux or once they reached the five star limit (three mentions), how to make life (three mentions), how to position stars and/or planets (two mentions), how long a star would last until it died and how to understand the scale that appears at the bottom of each new star they created (one mention each).

- About half of the students said they found the answers to their questions by asking a classmate. Indeed, this finding was consistent with observations by the teacher who said that "students are teaching each other (and) learning from each other" on how to play. About half of the students also said they figured out how to play by "experimenting," with six of these saying they tried putting stars in different parts of the galaxy and three of these saying they "clicked on random buttons" to see what would happen. A few students each said they clicked on the "Help" button to get instructions (three mentions), took up the game's invitation to "click for more!" to get additional information about stars and planets and/or used background knowledge to determine how to proceed (one mention each).

- When asked what they liked best about playing *MyStar*, students offered responses that fell into three basic categories: content of the game they enjoyed, features of the game they enjoyed and general responses.

[7] Responses discussed in this and remaining sections of the report may sum to more than 100% because more than one response was accepted for each question. In addition, counts may not total the sample size because students were not required to answer every question.

Content of the game students enjoyed (n=12): Many of these students said they liked watching and/or learning "how stars develop"; many also said they liked "trying to figure out how life can start"; a few also said they liked building planets around their stars.

Features of the game students enjoyed (n=12): Many of these students said they liked the ability to "customize" their stars, including naming them and choosing their colors; some also said they liked "that you can see other people's stars"; some said they liked the timeline and watching systems evolve in a short time; some said they liked getting starbux after every hour and/or after taking specific actions.

General responses (n=4): These students indicated they liked everything about the game saying it was "informative," interesting and exciting.

- As far as what they liked least about playing *MyStar*, two-thirds of the students said they became "impatient" waiting to earn enough starbux/points (i.e., in order to take the next action), as the representative comments below indicate:

  "You have to wait kind of a long time to get more money."

  "I had to wait to get the ten points to reach the 'Planeteer' feat and until then there is nothing else to do."

  "It takes a very long time for planets to develop and to get more starbux to do more things….and after you get paid, it's a very small amount so you can't really do anything."

One-third of the students also said they found it "annoying" that they could only have a maximum of five stars at a time. As one student said: "I thought I could create a lot of stars because it's the galaxy (so I didn't like) the limit of stars that you can buy (which is) just five…I couldn't play for a week because my stars wouldn't die out."

A few students each also said they did not like their lack of control over a star's continued evolution or demise (three mentions), the limited time in which to build a planet (two mentions), the lack of specific directions, the fact that some stars burn out and the large number of points needed to get to the next level (one mention each).

- When asked for ways to improve the game, only one student said he had no suggestions. The remainder offered recommendations that fell into three categories, as follows: new actions players could take, other ways to earn starbux and ways to improve game features.

  New actions players could take (n=10): Some students wanted to be able to buy more than five stars; a few students each wanted to make moons, buy an asteroid belt ("so that eventually the asteroids would collide and create a planet"), create another galaxy, create disasters together with ways to save a planet, play games about space and increase the number of actions that can be taken at each level (one mention each).

  Other ways to earn starbux (n=8): Many students suggested decreasing the time between payouts; some wanted to do activities like quizzes to get more money; a few each said lower the purchase price of each action, increase the amount of money that is paid out each hour and "make how many starbux you get an hour dependent on what level you are because there are people in my class who are Level 1 and 2 and they all get the same starbux that they start out with; I'm Level 6 and I have the same amount of starbux (that they do)" (one mention each).

  Ways to improve game features (n=8): Many students wanted more detailed instructions on how to play (e.g., "There should be a tutorial"); some said "Have a chatbox so you can talk with other people about how they named their stars and stuff"; a few each said "It would be good to see others' feats," "You should get to see an animation of your star, like how it looks (in real life) or its magnetic field," "Have it be a shorter time between the stages to evolve life" and "Stop evolution when you log off so that when you log in again, you can pick up where you left off" (one mention each).

Students' understanding of *MyStar*

- Almost two-thirds of the students said the object of the game is to develop stars, planets, a solar system or a galaxy "like ours"/"with life"; about one-third said the object is more simply to make or build stars, planets, a solar system, galaxies, and/or a universe. A few students each also thought the object is to "get achievements/feats" (four mentions) and to "get as many points/starbux as possible" (three mentions). Other objectives students mentioned included "challenge yourself," "have your own creativity" and "learn the orbit of the stars and the planets" (one mention each).

- The majority of the students could state two things they learned about stars from playing *MyStar*; only a few could state one thing. Students' statements about what they learned fell into four basic categories: lifecycle of a star, characteristics of stars, the relationship of stars and planets and the possibility of life.

Lifecycle of a star (n=15): Many of these students either noted generally that "the lifetime of a star depends on its size" or specified that "larger stars often have a shorter lifespan than smaller stars"; a few each said that "stars live longer depending on where they are located" (three mentions), "stars evolve over a long time," "the evolution of a star can be unpredictable" and "stars turn into white dwarfs or black holes depending on how they start out" (one mention each).

Characteristics of stars (n=9): Many of these students stated that "there are different sizes of stars"; a few each noted that "there are different types of stars" (two mentions), "stars can be larger than planets," "stars have different brightness," "the color of a star determines its brightness" and "stars are unique—each has its own 'traits'" (one mention each).

The relationship of stars and planets (n=5): These students talked about stars in relation to planets, planets in relation to stars or planets in relation to each other, saying "a star will not be stable if (a planet) is too close to it," "stars need enough power to support a planet" "a planet needs a star to develop," "planets must be a certain distance from the sun to survive" and "planets close to each other can collapse" (one mention each).

The possibility of life (n=4): These students said they found that "certain stars have a better chance to create life" (two mentions) and that "planets must be a certain distance from stars/other planets to sustain life" (two mentions).

Other statements that students made regarding what they learned from playing *MyStar* included: "It takes a long time for stars to revolve/orbit around the galaxy" (two mentions) and "When you click for more information, you can go to Hubble, which gives you more information and pictures about stars" (one mention).

- Students were asked to answer three true/false statements:

  (1) *The lifecycle of a star is mostly determined by its initial mass*,
  (2) *A galaxy has "habitable zones" where planetary formation or life is more likely*, and
  (3) *Stars can evolve quickly, for example they can be born and die in a person's lifetime*.

  Six students (all male) answered the three statements correctly; eleven students (six female and five male) answered two of the statements correctly; three students (two female and one male) answered one of the statements correctly.

  Students were also asked to provide explanations for their answers to the true/false statements, which are described in Tables 4, 5 and 6 below. Students' explanations demonstrated a range of understanding about each concept (i.e., from general to specific and/or from accurate to inaccurate).

Table 4. Students' responses to the first true/false statement.

Statement: *The lifecycle of a star is mostly determined by its initial mass.*	
True (n=14)	Most of these students offered general observations for why the statement is true, including eight who said "Big stars don't live as long as small stars," or conversely "Small stars live longer," and one each who noted that "bigger stars are white in color and smaller stars are yellow" and "If the star is too small then it would die and if the star was the perfect size then it would stay alive and planets around it would have life." Some of these students offered more specific explanations for why the statement is true, such as two who said "Smaller stars last longer because they burn off their energy slower than the big stars," two who said "Big stars last longer because they have more gases, which cause nuclear fusion and give them more energy" and one who said "Red giants have less mass and less nuclear fusion in its core, which means as it develops, it turns into a supergiant and explodes into a supernova, which ends up as a black hole."
False (n=4)	Two of these students said they did not know what the lifecycle of a star mostly depends on; one each said the lifecycle of a star depends on "how the star is rotating and how close it is to the sun" and "planets."
Don't know (n=2)	These students could not offer any explanation regarding the lifecycle of a star.

Table 5. Students' responses to the second true/false statement.

Statement: *A galaxy has "habitable zones" where planetary formation or life is more likely.*	
True (n=14)	Many of these students specifically noted that, in playing the game, they could not make life in the outer rings/parts of the galaxy but could make life in the galactic bulge/center/star forming region, with a couple of students adding that "the outer region doesn't have enough debris to create new planets." Some of these students indicated that they "haven't figured out what the zones are yet." A few of these students offered more general observations for why the statement was true, including one who said "if you were to create a star in a specific zone, sometimes the zone would not have the requirements for the star to survive" and one who said "if you don't have that much money, you can't buy planets that would live a long time or that people could live on." A few of these students offered explanations about the possibility of life that did not have to do with a galaxy's habitable zones (e.g., "If your planet is too close or too far from the sun, it can't have life"). One other student offered a general comparison between the milky way and other galaxies.
False (n=4)	Two of these students offered explanations that suggested they in fact had a partial understanding of the concept, with one noting that planetary formation is more likely "in the center of the galaxy because that is where a terrestrial cycle comes" and the other saying "in the star nurseries, where the gas clouds are and there is more material to create stars and planets." One of these students said he did not know where planetary formation is likely because "I didn't get (to that point in the game) yet." One of these students said the statement was false because "(planetary formation) depends on chance."
Don't know (n=2)	One of these students said she did not know the answer but indicated she was waiting to find out how the planet she had just created in the "nucleus of the galaxy" would fare; the other offered no additional explanation for her answer.

Table 6. Students' responses to the third true/false statement.

Statement: *Stars can evolve quickly, for example they can be born and die in a person's lifetime.*[8]	
False (n=15)	The majority of these students indicated that stellar evolution is longer than a person's lifetime (e.g., "In the game, every minute is like a million years") and offered estimates that ranged from "a couple of million years" to "billions and billions of years"; only one student could not say how long it might take for a star to evolve.
Don't know (n=4)	Three of these students could not say how long stellar evolution might take; the other student said "five minutes in reality is like 2 million years in the game and the star has gotten bigger," which suggested she in fact had an accurate understanding of the concept.
True (n=1)	This student said the statement is true because "one of my stars died; it didn't survive where it was."

Interestingly, there was scant evidence that the number of days that had elapsed between the students' join date and their interview date, or the feats they achieved within that time period had much bearing on getting the statements right (See Table 7 in Appendix D).[9]

- In response to the last interview question, "What are some things that might prevent a planet or world from supporting life?" only two students said "I don't know" and the remainder offered a variety of responses.

  Of the students who offered responses, most indicated that "the distance between a planet and the star it's orbiting" determines whether life is possible, with five students also adding that the distance from the star affects the temperature on the planet (e.g., "If the planet is too far from the star, it's too cold to support life") and three students also adding that distance can affect gravity (e.g., "If the planet is too close to the sun, then the gravity will attract the planet too close"). Some students indicated that "the stuff around a planet" such as black holes, space debris, gamma rays, asteroids, space rocks and/or other planets might prevent that planet from supporting life.

  A few students also noted that the lack of an atmosphere might prevent a planet/world from supporting life; a few indicated that the extent to which the star/sun is active is a factor; a few said life is not possible without water; a few said "gravitational pull" is a factor. A few students offered other reasons that would prevent a planet/world from supporting life, including its location in the galaxy, the type of planet it is and the temperature and gases on the planet (one mention each).

[8] After the interview with the first student, IES clarified to all subsequent students that the statement should be considered in real time.

[9] Moreover, no causal relationship was found between the days students actually logged in to the game or the number of times they spent starbux, ostensibly "learning moments" in the game.

CONCLUSION & RECOMMENDATIONS

Overall, *MyStar* appears to be an enjoyable and "informative" game that effectively meets its top three learning goals. The majority of the students in the sample understood the object of the game to be about building stars, planets or a solar system, with most specifying that these should be "like ours." The game also kept students interested over the course of the study period, with the majority logging into it outside of class, as well as in class. Students noted that there were various aspects of the game they liked, including in particular "learning how stars develop" and "trying to figure out how life can start"; students said they also liked the ability to "customize" their stars and being able to "see other people's stars" in the galaxy.

When asked what they specifically learned about stars, the majority of students could mention two things, including mainly facts about the lifecycle of a star (e.g., "the lifetime of a star depends on its size"); to a lesser extent, students also mentioned having learned something about the characteristics of stars, the relationship of stars and planets and/or how life might be possible. When asked what might prevent a planet or world from supporting life, most students mentioned the distance between that planet/world and the star it orbits, especially, as a number of students explained, how distance influences the temperature on or the "gravity" of the planet; some students also indicated that "stuff around a planet" such as black holes, space debris, gamma rays, asteroids, space rocks and/or other planets might prevent that planet from supporting life. Other life-preventive factors that students mentioned included the lack of an atmosphere or water, the extent to which the star is active and "gravitational pull," responses that pointed to students' strong background in astronomy.

Out of a possible 17 different feats that students could achieve, the average number was five within the study period; only a few students could be considered high achievers with more than 10 feats accomplished by the end of the study period. Indeed, these high achievers spent more than 600 minutes with *MyStar*, which indicated that the more time students spent playing, the more feats they achieved. Interestingly, however, there was scant evidence that the number of feats students achieved between the date they began playing *MyStar* and the date they were interviewed had much bearing on what they learned. For example, when asked to respond to three true/false statements (which were essentially about the first three learning goals), the majority of students answered at least two of the three statements correctly—even though they had achieved only 1 or 2 feats. Thus, it may be that a combination of all the actions students took in the game, as well as prior knowledge, contributed to learning.

A number of students indicated that they did not find it very easy to get started playing the game, with students rating that aspect of the game (i.e., figuring out what to do) a 3.65 on a scale of 1 to 7, where 1=very easy and 7=not easy at all. Many students said they turned to their classmates for help; many also figured out how to play by "clicking random buttons" or "experimenting" with different strategies. Once they got underway, students indicated they were frustrated by other aspects of the game. In particular, most noted that they became "impatient" waiting to earn enough starbux to take the next action, in part because "there is nothing else to do" while the starbux accumulate. Some students also found it "annoying" that

they could have a maximum of five stars at a time, again because they could not play until at least one star died out.

In terms of ways to improve the game, students offered several recommendations, a number of which IES would agree that SSI might consider.

- In particular, students wanted to be able to buy more than five stars, as well as other items to add to their systems such as moons and asteroid belts. Certainly, inviting players to take these types of actions would help to reinforce some of the game's current learning goals (as well as possibly introduce new ones). To the contrary, the current purchase limit may lead players to abandon the game, especially since it can take several days—if not weeks—for stars to die.

- Students also suggested other ways to earn starbux, including reduce the time between payouts, increase the amount of money that is paid out each hour, lower the purchase price of each action and build in quizzes for players to do. That said, if the reason for the drawn out payouts (and therefore the relatively slow pace of the game) is to give players a sense for how long stellar evolution actually takes, then perhaps the first three suggestions are moot. However, the last recommendation to add quizzes is worth considering, in particular because they could provide an entertaining way for players to pass the time while they wait for the starbux to accumulate and their stars, planets and/or systems to be "just right" for life to occur. Furthermore, quizzes or other games would be an effective way to help players test their knowledge and reinforce their understanding of the concepts behind the game.

- Students wanted more specific instructions on how to play the game. This could be accomplished with a tutorial, as one student noted, or by offering more explicit directions with an expanded "Help" function (for example, as IES found when using the "Help" function, the message that "clicking on planets will give you more information" was frustrating given that no "planets" button was available). In addition, IES would suggest including a glossary of terms or basic facts about astronomy ("Celestial Clues") that players can refer to and apply in the game. This would seem to be especially important if the game is to be made available to the general public, as well as those specifically interested in or knowledgeable about astronomy.

- Several students suggested adding a chatbox so they could talk with their friends "about how they named their stars and stuff." Indeed, given that students relied on their classmates to help them get started on and progress through the game, such a function would seem to be essential to keep players motivated. However, it may be necessary to test the chatbox function in a non-community learning setting given that, in this study, the success of *MyStar* seemed due in part to the fact that players could teach and learn from each other. IES would also recommend testing the next iteration of the game with a sample of people who are not specifically knowledgeable about astronomy in order to

have a more accurate assessment of how the chatbox feature (indeed the game itself) would fare under more "realistic" circumstances.

- Finally, with regard to other features that might need modification, IES would suggest that as players mouse over the galaxy to find out the cost of placing a star in a given area the messages that pop up might more clearly state that the area "Starts at [a minimum number] of starbux." In this manner, players can avoid disappointment at finding out that, in fact, they do not have enough starbux to build a star (or the kind of star they want). In the same vein, IES found that when a player has reached the five star maximum, it is not possible to see what things cost when one mouses over the galaxy. As such, there is no way to get an idea of how much would be needed the next time there is an opportunity to take an action (i.e., buy something).

Appendix A-Student Interview Guide

Space Science Institute	**Date: _____**
MyStar Summative Evaluation	**Interview #: _____**
Gender: M F	**USER ID: _____**

First let's talk about playing the game.

1. Where did you play? (check all that apply)
   School/club ___ Home ____ Elsewhere: _____

2. What did you build first….second….third?

   First:

   Second:

   Third:

3. What feats did you accomplish?

4. How easy was it to figure out what to do on a scale of 1-7, where 1=very easy and 7=not easy at all?

   Very easy 1 2 3 4 5 6 7 Not easy at all

   Probes for 2-7 response: What were some things you had questions about or what were some glitches you found? How did you figure out the answers?

5. How long did you play (over what period of time)?
   Once or twice ____ A few times during the course of a week ____
   Several times during the course of 2+ weeks ____

6. How long do you think you spent playing each time you logged on?

   Less than five minutes at a time ____ More than five minutes at a time ____

7. What did you like *best* about playing My Star? (Ask why)

8. What did you like *least* about playing My Star? (Ask why)

9. If you could make any changes to the game, what would you do? (Ask why)

Now let's talk about what the game is about.

10. If a friend asked you what the object of the game is, what would you tell him/her?

11. Can you tell me 2 things about stars that you learned from playing this game?

    1.

    2.

12. Now I'm going to read you three sentences. Please tell me if you know whether they are True or False. If you don't know, it's ok to say "I don't know."

    (1) **The lifecycle of a star is mostly determined by its initial mass**. True False D/K

    If "True" ask: Can you tell me more about that or give me an example of how that worked in the game?

    If "False" ask: What does the lifecycle of a star mostly depend on?

    (2) **A galaxy has "habitable zones" where planetary formation or life is more likely**.
    True False D/K

    If "True" ask: Can you tell me more about that or give me an example of how that worked in the game?

    If "False" ask: Where is planetary formation or life more likely?

    (3) **Stars can evolve quickly, for example they can be born and die in a person's lifetime**.
    True False D/K

    If "True" ask: Can you tell me more about that or give me an example of how that worked in the game?

    If "False" ask: How long does stellar evolution usually take?

Ok, we're almost done. I just have one more question.

13. What are some things that might prevent a planet or world from supporting life?

Thank you so much for your help! As a thank you, you will receive a small gift that I will send to your teacher to give to you.

Appendix B-Consent Form

MyStar Online Game Assessment
Dr. James Harold, P.I.
Space Science Institute

Parent/Guardian Consent Form

The students in your child's astronomy class have been invited to play an online learning game called MyStar, which can be accessed at http://www.alienearths.org/mystar/. The game has been developed by the Space Science Institute and is a prototype for future learning games designed by the Space Science Institute. The Space Science Institute is working with an independent evaluator, Kirsten Büchner of Insight Evaluation Services, to test the game and would like to request permission for your student to participate in a small assessment study.

Procedure
The purpose of the study is to understand the extent to which MyStar effectively communicates key messages about stars. Participation in the study includes having students play the game for 2-3 weeks; students will be assigned a login name in order to track their activities while they play. On a mutually agreed upon date/time established between the evaluator and your child's teacher, students will then be interviewed about what they think of the game in terms of its usability and content. Students would also be asked for their suggestions on ways to improve the game. The interviews will be conducted via telephone by the evaluator and would be between 10-15 minutes long. At the end of the study, each student will receive a small gift to thank them for their time.

Risks and Confidentiality
There are no known costs or risks associated with participation in the study. Students' names will not be collected via the game or during the interview. Students will only be asked to provide their login name during the game and at the beginning of the interview. If you agree to allow your child to participate in the telephone interview, your child's teacher will supervise the interaction between the evaluator and the student. All responses will be reported in the aggregate so that they cannot be traced to any individual student and no personally identifiable information will be connected to any reports or published records associated with the assessment. Only the evaluator and Space Science Institute staff will have access to log data and interview responses. These data will be stored securely by the evaluator and SSI and no other copies will be made. After three years, this information will be destroyed.

Voluntary Nature of the Study
Participation is voluntary and your child is free to withdraw at any time. Your decision whether or not to participate will not affect your child's grades, nor will it have any impact on current or future relations with the Space Science Institute.

Contacts and Questions
If you have any questions now or later, you are encouraged to contact our evaluator any time via email at kirsten@insighte.net or by phone at 703.606.7976. You may also contact the project Principal Investigator, James Harold, at harold@spacescience.org or by phone at 720.974.5858. Please refer to your child only via his/her login name which can be obtained from your child's teacher.

An Independent Review Board (IRB) is also available to you if you have any questions or concerns that you do not wish to discuss with the evaluator or the Principal Investigator. You may contact Dr. Paul Dusenbery, IRB Chair at the Space Science Institute at dusenbery@spacescience.org or via telephone at 720.974.5822.

If you agree to allow your child to participate, please complete the information below and have your child return the form to [Teacher's Name] by May 13, 2011. Please also keep a copy of the form for your records. Thank you.

Statement of Consent

I have read the previous page. I understand that my child is being asked to participate in the assessment of the MyStar game being developed by the Space Science Institute. I have had the opportunity to ask any questions I might have.

___ Yes, I agree to allow my child to participate in the assessment of the MyStar game. I understand that my child will be asked about how s/he played game, what s/he learned, and whether s/he would recommend any changes. I understand that participation is voluntary and I am free to withdraw my child from participating in the study at any time. I understand that all responses provided by my child will be anonymous and confidential**.**

Student's Name (Print): _____

(a) Student's Signature: _____ Date: _____

Parent/Caregiver Name (Print): _____

(b) Parent/Caregiver Signature: _____ Date: _____

(c) Teacher's signature: _____ Date: _____

Please note: For purposes of this consent form, (a) is the signature of the person who consents to participate; (b) is the individual who witnesses the process of obtaining informed consent; and (c) the individual who obtains the consent of the subject.

For Teacher use only:

User ID _____

Appendix C-Teacher Instruction Letter

May 6, 2011

[Teacher Name]
[School Name]
[School Address]

Dear [Teacher Name],

Thank you for agreeing to participate in the assessment of MyStar, the online learning game developed by the Space Science Institute (SSI). This letter is to outline the methods by which we, as the independent evaluators contracted by SSI, would like to collect feedback from the students in your class. We very much appreciate your help in assisting us with this effort.

Attached to this letter is a statement of informed consent, which briefly describes the project, assessment procedure, risks and confidentiality, voluntary nature of the study and contact information in case of any questions regarding the assessment. We would like you to distribute these consent forms to your students so that they and their parents may read and sign if they are willing to participate in the assessment.

When you receive a completed form from a student, we ask that you sign and date the form as well. As you receive the consent forms, we would like you to assign each participating student with a login name (or identification code) from a list of codes that we will provide to you.

Please make a separate list for yourself that matches students' names with their individual code as that is how students will be known for the duration of the study. We ask that you store this list in a secure location at all times so that no one else may have access to it.

Once you have received all the consent forms, we ask that you mail them to the Space Science Institute in an addressed and stamped envelope that we will provide to you.
We ask you to encourage the students to play over the course of two weeks as the game evolves slowly over time. Each time students access the game, they should be instructed to use

their assigned login name only. Part of the assessment is to understand what activities students do while they are playing the game, however they should remain anonymous while these activities are tracked.

After the two-week play period, we would like to coordinate with you the dates and times to conduct the telephone interviews with students. We would like to speak with a maximum of 20 students. Given that interviews will take between 10-15 minutes each, we estimate that we will need between 3-5 hours to collect all interview data.

Specifically, we will telephone your class at a number provided by you and ask that you call students to the phone one by one. Students should not be identified by name but rather by their login name/identification code. We would ask you to supervise the interaction between the evaluator and the student; you or another staff member are also welcome to listen in on the conversation to monitor the interaction.

Once all the interviews are complete, we will send you a small gift to give to the students to thank them for their time and participation in the study. Once the gift has been distributed, we ask that the list that matches student names with their identification codes be destroyed. Once this is done please notify the IRB chair and project P.I. by email at dusenbery@spacescience.org and harold@spacescience.org.

Please let us know if you have any comments, questions or concerns regarding the methods outlined in this letter. Again, thank you for your help and participation in this assessment; we look forward to working with you.

Sincerely,

Kirsten Büchner
Insight Evaluation Services
5318 Orchardson Ct.
Fairfax, VA 22032
(703) 606-7976

www.insighte.net
kirsten@insighte.net

Appendix D-Table 7

The feats students achieved between their join date and interview date and their responses to the three true/false statements.

Student	User ID	Join Date	Interview Date	Number of feats achieved	Stmt 1*	Stmt 2*	Stmt 3*
5	45	5/24/2011	6/2/2011	2	1	1	2
1	46	5/24/2011	6/2/2011	1	1	1	3
11	47	5/24/2011	6/8/2011	9	1	1	2
10	48	5/24/2011	6/6/2011	5	1	2	2
6	49	5/24/2011	6/6/2011	6	1	1	2
2	50	5/24/2011	6/2/2011	1	1	1	2
9	51	5/24/2011	6/6/2011	2	1	2	2
8	52	5/24/2011	6/6/2011	1	1	1	2
7	55	5/24/2011	6/6/2011	2	1	2	2
16	56	5/24/2011	6/10/2011	2	2	1	2
17	57	5/24/2011	6/10/2011	1	3	1	2
13	58	5/24/2011	6/8/2011	1	3	2	2
15	60	5/24/2011	6/8/2011	1	2	1	2
3	61	5/26/2011	6/2/2011	3	1	1	3
20	62	5/26/2011	6/14/2011	2	2	1	1
12	63	5/26/2011	6/8/2011	3	1	3	3
4	64	5/26/2011	6/2/2011	1	1	3	2
14	65	5/26/2011	6/8/2011	2	1	1	2
18	66	5/26/2011	6/14/2011	1	2	1	2
19	71	5/31/2011	6/14/2011	1	1	1	3

*True=1, False=2, Don't Know=3

Correlation of number of feats achieved to each statement:

stmt 1 r= -0.3265
stmt 2 r= -0.02968
stmt 3 r= -0.05418