INSTITUTE FOR LEARNING INNOVATION

WolfQuest Summative Evaluation
Full Summative Report

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Table of Contents

Executive Summary

The Institute for Learning Innovation (ILI) conducted a summative evaluation of the NSF-ISE funded project, WolfQuest. WolfQuest is an educational video game, downloadable free of charge, developed by Eduweb (Educational Web Adventures, Inc.) and the Minnesota Zoo. WolfQuest intends to increase the knowledge of, interest in, and attitudes towards wolves and wolf habitats in children ages 9 to 15. This evaluation report synthesizes key analysis and findings from data based on a web survey of players, in-depth phone interviews of players, and content analysis of the game conversation forums.

WolfQuest has a large audience—on average, players engage in over 100,000 multiplayer game sessions per month. While WolfQuest was a downloadable game available to anyone, the game achieved reaching its target audience of 9-15 year olds, with nearly 70% of players coming from that age range.

Analysis shows that player interest in, connection to, and knowledge regarding wolves, their behaviors, and their habitats has increased significantly. This is despite the fact that STEM-content knowledge was woven throughout the game and rarely, if ever, explicitly "taught". Individuals playing WolfQuest also report a stronger emotional attachment to wolves after playing the game. Emotional connection has a statistically significant negative correlation with incoming self-ranked knowledge, so that individuals who rank themselves as experienced or expert were less likely to report that *WolfQuest* increased their connection to wolves.

In self-reported knowledge, there is a definite cognitive gain, with respondents naming either general or specific items they learned, including facts related to habitats, hunting behaviors, territories and threats to wolf survival, social behaviors, and other wolf facts related to the anatomy and species of wolves.

After playing WolfQuest, players continue with other wolf-related learning and behaviors. Over three quarters of the survey participants either actually or intended to look up information about wolves, watch videos or television shows about wolves, read further about wolves, make art about wolves and talk to friends and family about wolves and the WolfQuest game specifically. Over half of the individuals connect playing WolfQuest with their desire to visit zoos, nature centers and state parks and to participate in outdoor activities. Overall, age was a strong contributing factor in subsequent behavior, as younger players are more likely to show behavioral change than older ones. The amount an individual plays WolfQuest is also correlated with behavior change, with individuals who played more likely to exhibit the intended behaviors.

WolfQuest players demonstrated the use of scientific habits of mind, including model-based testing, social construction of knowledge, and use of evidence, in their problem-solving and discussions around problem-solving. While this finding corroborates findings elsewhere in current gaming research, it is notable in that it demonstrates these skills at a younger level and within the context of a learning game.

Throughout the evaluation, WolfQuest was shown to be a highly effective in achieving the goals laid out, and providing a rich and rewarding learning experience for the players. While this was an evaluation of a particular game, rather than a research study of STEM-related gaming, it raises several topics for future potential research.

I. Project Background & Overview

In October 2006, the Minnesota Zoo and Eduweb (Educational Web Adventures, Inc.) were awarded a three-year National Science Foundation grant to develop a free downloadable online game about wolves (WolfQuest); a supporting website about that game that features a discussion forum (www.wolfquest.org), and a national network of informal science education (ISE) institutions to offer WolfQuest-related programming. WolfQuest is intended to bring the compelling qualities of commercial video games to online informal science learning in order to teach wolf behavior and ecology.

The game itself is a unique downloadable single- and multi-player 3D wildlife simulation game that allows players to customize a wolf avatar and then experience life as a gray wolf. Players carry out missions that involve interaction with other wolves and their environment as they struggle to survive and reproduce. The WolfQuest website is a rich source of game information and previews, a discussion forum where players share strategies and tips for playing the game, as well as their thoughts and interests in wolves and other related paraphernalia (e.g. wolf art, poems, etc.). The website also hosts a multimedia library of information about wolf ecology and conservation.

The Institute for Learning Innovation (ILI) was contracted by the WolfQuest design and development team to provide a summative evaluation of the WolfQuest Project. Relevant potential outcomes included cognitive, affective, and behavioral goals in the form of knew knowledge and awareness, attitudes and interests, skills and behaviors for a target audience of 9-15 year olds.

The evaluation study design created by ILI was driven by a set of evaluation questions related to the WolfQuest project goals, corresponding to the NSF-ISE categories of impact (Friedman, 2008). Those questions and their appropriate NSF ISE impact categories were:

- Does playing WolfQuest and visiting the website and/or forum increase knowledge of wolf behaviors and ecology? (Impact category: Awareness, Knowledge, or Understanding)
- Does playing WolfQuest and visiting the website and/or forum increase interest and positive attitude towards wolves and their habitats? (Impact category: Engagement or Interest)
- Does playing WolfQuest and visiting the website and/or forum increase intended or actual wolf-related conservation behaviors? (Impact category: Behavior)
- Does playing WolfQuest and visiting the website and/or forum support or reinforce scientific habits of mind? (Impact category: Skills)

II. Methods

To answer the evaluation questions, ILI designed a multiple method approach in which the weaknesses of one method were balanced and accounted for by a triangulation of another method. This report is based on data from three complementary methods:

1. a web-based questionnaire, surveying current and former players (n=964) (a statistically representative subsample of 280 web survey participants was extracted for use in analysis of open-ended responses);

2. telephone interviews of visitors intercepted while visiting the WolfQuest website (n=40); and

3. an analysis of one WolfQuest community forum (based on 321 randomly chosen threads containing 2,834 posts), using a coding rubric for scientific habits of mind.

Web-based Questionnaire

Instrument

ILI designed a web-based questionnaire using Vovici EFM Continuum (formerly known as Websurveyor) to capture the broadest level of information and feedback from a range of WolfQuest players (see Appendix A). The survey included a series of closed- and open-ended questions to capture self-reported information related to each of the STEM outcomes, as well as gather data on a set of independent variables for cross-tabulation and statistical analysis.

Fourteen (14) closed-ended questions, including yes/no, multiple choice, and ordinal scale-type questions, assessed game players':

- use of the website components and game;
- attitudes and interests towards wolves and wolf habitats;
- perceived wolf knowledge before and after playing the game; and
- intended or actual follow-up behaviors as a result of playing the game.

Nine (9) open-ended questions were used to:

- support and expand upon certain closed-ended questions;
- identify specific knowledge gain related to wolves, as well as their hunting practices, and survival skills;
- assess scientific habits of mind supported by WolfQuest game play and use of website activities and forum; and
- identify additional behaviors resulting from game play.

Independent variables included demographic and psychographic characteristics:

- type of gamer (Bartle, 1996)
- frequency of general gameplay
- frequency of WolfQuest gameplay
- type of gameplay (multi- or single-player)
- prior zoo visitation
- wolf knowledge
- geography/location
- age

Recruitment

Web survey participants were recruited through a promotional paragraph and URL included on the monthly WolfQuest newsletter (see Image 1 below). Of the 223,000 people who downloaded the game (as of December 15, 2008), 59,000 gave their email address (about 26%). The mailing list for the newsletter was comprised of those individuals who confirmed their email in a confirmation request. This particular newsletter went out to approximately 17,000 individuals (note: there was also some technical difficulty in sending out the newsletter, which may have reduced the initial mailing list to this number).

Image 1: Screen capture of WolfQuest newsletter used for recruitment. Retrieved November 29, 2008, from http://wolfquest.org/wq_newsletters/wq_nov08_newsletter.html

The newsletter was sent out in batches on November 20, 30, and December 1, 2008. Of the 17,000 WolfQuest players alerted by the newsletter, 971 individuals participated in the web survey, which ran from November 20 - December 13, 2008 (nearly 2.5 times the number needed for a representative sample to a population this size; see Krejcie, 1970; Table 1). Participants who responded with profane or nonsensical language as well as entirely blank responses were removed from the sample. The final sample for the web-based survey was n=964.

Subsample

A subsample of the web survey participants was extracted for use in analysis of qualitative responses. Using an effect size calculation table (Krejcie, 1970; Table 1), 280 cases were randomly selected from the web survey population using SPSS 15.0 statistical software.

Data entry and reduction

Closed-ended questions were analyzed with descriptive and inferential statistics using SPSS 15.0

statistical software. Open-ended, or qualitative, responses were coded using a primarily emergent coding rubric (see Appendix C), and then entered into the same SPSS database for descriptive analysis and cross-tabulation with independent variables. Questions related to overcoming challenges and playing in multi-player mode were coded deductively with an adapted coding rubric established by Steinkuehler and Duncan (2008) relating to scientific habits of mind expressed in virtual worlds forums.

Telephone Interviews

Instrument

As the second method, ILI researchers conducted in-depth, semi-structured phone interviews. The goals of those interviews were to:

- document players' intended versus actual behaviors related to wolves and conservation;
- collect qualitative information to enrich the web survey data related to prior interest and change in interest;
- better understand problem solving strategies that game players used (scientific habits of mind); and,
- capture questions that were not suitable for the web survey such as the idea of preservation and habitat importance.

In particular, the high percentage of agreement to many of the behavioral questions in the web survey led researchers to probe more deeply on this topic to ascertain the variability between intended versus actual behaviors. Also, scaled questions on the web survey with high mean ratings, such as interest or knowledge, were investigated more deeply to determine the degree to which the respondents were using a survey response strategy determining that relies on a underlying construct of adequacy, rather than an optimal situation. (Krosnick, 2000).

Five closed-ended questions of the yes/no and ordinal scale type were used to understand post-game play interest in wolves; concepts related to the perceived importance (or not) of preservation issues; multi-player gaming activity; and finally intended versus actual behaviors.

Eight open-ended questions were used to support and expand on responses to closed-ended questions; assess scientific habits of mind supported by WolfQuest game play and use of website activities and forum; and identify examples of different behaviors and activities engaged in by participants as a result of playing the game.

Recruitment

Participants were recruited using an online remote-user recruitment application called Ethnio (www.ethnio.com). With this application, a piece of DHTML was embedded into the homepage of the WolfQuest website. During a range of times (including morning, afternoon, and evening) during a study period starting February 18, 2009, and ending April 2, 2009, visitors to http://www.wolfquest.org/ were greeted with an invitation to participate in a brief telephone interview (see Image 2 below). (Note: the screener was only activated for the website at the precise times that a researcher was planning to do interviews, unless there was a technical difficulty; the screener was otherwise not active 24 hours a day during the study period.)

Image 2: Screen capture of sample pop-up invitation on the WolfQuest website. Retrieved May 6, 2009 from http://www.ethnio.com/rest/screeners/1257/edit. (Note: This was not the actual invitation, nor was an incentive offered for participation in this particular study.)

If players indicated that they were interested in an interview, they were then prompted by a screener of 10 questions capturing the following information:

- age;
- availability of a parent/guardian to approve the interview (if necessary);
- state;
- prior visitation to the Minnesota Zoo;
- prior interest in wolves (before playing the game);
- frequency of WolfQuest game play;
- frequency of general game play; and,
- telephone contact information for the interview.

Sampling

Based on information provided by the screener, researchers chose a stratified sample of the respondents who answered each of the 10 questions. Individuals in the target audience of 9-15 year olds as well as those indicating a lower prior interest score to wolves were prioritized. A total of 621 individuals responded to the screener. Technical difficulties with the screener occurring from 8:20pm on March 1, 2009, through 1:22pm on March 4, 2009, collected 233 unusable recruits. Of the remaining 388 recruits, 81 individuals were considered valid to call. An interviewee was considered valid if 1) a parent was indicated to be available for those under 18 years of age; 2) s/he indicated a phone number in the United States, and 3) if the individual had completed the remaining screener questions satisfactorily (i.e. they did

not include profane or nonsensical language). A total of 40 semi-structured phone interviews were then conducted by ILI researchers. Prior to conducting an interview with a minor, the researcher requested to speak with the parent or guardian who then gave consent for the interview. Only 1 parent preferred that their child not speak with a researcher, and the call was ended. (See Appendix B for the semi-structured interview protocol.)

Data entry and reduction

Closed-ended questions were entered into an SPSS 15.0 database and analyzed with descriptive and inferential statistics. Open-ended, or qualitative, responses were coded using a primarily emergent coding rubric - aligned with the coding categories identified when reducing the data for the web survey - and then entered into the same SPSS database for descriptive analysis and cross tabulation with independent variables. Questions related to overcoming challenges and playing in multi-player mode were coded deductively with an adapted coding rubric established by Steinkuehler and Duncan (2008) relating to scientific habits of mind in virtual worlds.

Forum Analysis

The goal of the forum analysis was to investigate the considerable amount of social interaction around the site, looking specifically at whether there was evidence of scientific habits of mind being reinforced by the game. The WolfQuest community forum presented a unique opportunity to tap into large quantities of unstructured qualitative data related to this aspect of the game. Of the myriad discussion areas that could have been analyzed, researchers selected the category of "Tips, Hints, and Help" as the area most likely to provide evidence of scientific habits of mind (see Image 3 below).

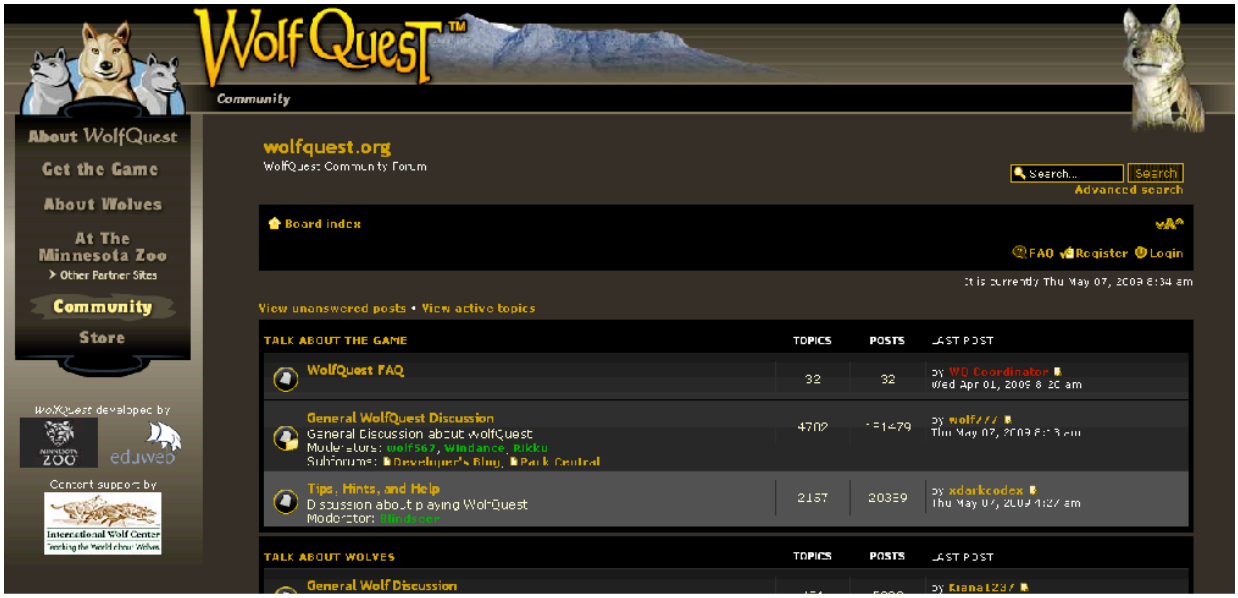


Image 3: Screen capture of the WolfQuest online community forum. Retrieved May 7, 2009, from http://www.wolfquest.org/bb/index.php.

The data analyzed for this particular study consisted of topics (also known as threads) within this discussion area occurring after the date of release of the first WolfQuest game, December 21, 2007 through March 25, 2009 - the date upon which Eduweb staff pulled down the contents of the backend of the forum for ILI researchers.

Sampling

Using an effect size calculation table (Krejcie, 1970; Table 1), 321 threads were randomly selected from the forum database of 18,821 total threads using SPSS 15.0.

Data entry and reduction

All of the individual posts within each thread were coded by an ILI researcher for scientific habits of mind, using the deductive coding rubric established during the web survey and phone interviews (example at Appendix C). This iteration of the adapted rubric most closely matched the one utilized by Steinkuehler and Duncan, which considered scientific habits of mind in the massively multiplayer online game, World of Warcraft.

Inter-rater Reliability

In order to assure that researchers were interpreting the codes in a similar way, a subset of 15 threads (approximately 5% of the data subsample) were selected to establish inter-rater reliability. Three researchers independently coded the posts within the subset of threads and then compared codes, identifying both agreement and any discrepancies, which were discussed and resolved through a consensus process. Changes were made to the coding rubric in order to clarify these issues, and then one researcher coded the complete sample of 321 threads, comprised of 2,834 posts with this revised rubric.

III. Evaluation Sample Description

Web Survey

There were 964 valid responses received to the online survey, representing players from every state in the union and 48 other countries. (The US and Canada accounted for just over 75% of the survey respondents; 63% of all WolfQuest players reside in the US and Canada.) The game successfully reached the target audience, as 67.2% of the participants were ages 9-15, and another 17.4% were 16-18. A total of 85.6% of the respondents were age 18 or under. Median age was 14 years old.

Respondents were daily video game players, including 51.3% of the target 9-15 year olds who were daily computer or video game players. According to the Pew Internet and the American Life Project, 50% of American teens age 12-17 and 21% of adults over age 18 play computer or video games daily (Lenhard et al., 2008, MacGill, 2008).

Table 1: How often do you play computer or video games?

Response Category	Percent
Less than once a week	8.6% (n=83)
1-3 times a week	22.5% (n=217)
4-6 times a week	21.9% (n=211)
Everyday	47.0% (n=453)

WolfQuest players tended to play often. While nearly half of our sample was playing the game for the first time when answering the web survey, the vast majority of the others had played WolfQuest frequently.

Table 2: How many times have you played WolfQuest?

First time playing	Played 2-3 times	Played 4-6 times	Played 6-11 times	Played more than 11 times
42.7% (n=402)	4/6% (n=43)	5.2% (n=49)	8.7% (n=82)	38.8% (n=365)

There is a variety of academic literature on the appeal of gaming and the different types of game players. While not central to the evaluation itself, we were curious to see how WolfQuest players would be defined within established typologies of game players.[1] Using a portion of Bartle's taxonomy of game players (1996), we asked participants to pick a statement, based on Bartle's work, which best matched how they play computer or video games. Each of these statements linked with a type of player, as can be seen in Table 3 below. While Bartle recognizes that these traits are "stereotypes" and that any individual player may embody multiple traits in multiple settings, it is revealing that overwhelmingly WolfQuest players described themselves as Explorers. Intuitively, it makes sense that WolfQuest would appeal to this type of gamer; it is not a first-person shooter-type game, and while there are goals to achieve, it is not a game with a significant emphasis on levels or points.

Table 3: Preferred type of game play (Bartle's Taxonomy)

Statement about preferred game play	Type of player	Percentage
I am most interested in discovering new parts of the game and creative ways to advance through it.	Explorer	76.6% (n=738)
I am most interested in getting to know other people like me who play the game.	Socializer	13.8% (n=133)
I am most interested in mastering the game and scoring the most points.	Achiever	7.5% (n=72)
I am most interested in attacking as many other players as possible.	Killer	2.2% (n=21)

[1] http://onlyagame.typepad.com/only_a_game/2007/05/the_nine_basic_.html

Telephone Interviews

Telephone interviewees were recruited in an informal stratified method, attempting to reach individuals primarily in the target age range who had low to medium incoming wolf knowledge and interest. This approach was selected to better understand the behaviors of the target audience, especially those who had low to medium incoming interest in wolves. Over half (62.5%, n=25) of the telephone interviewees were ages 9-15, and another 12.5% (n=5) were ages 16-17. The remaining one-quarter of the interviewees were over age 18. Similar to the web-based survey, nearly half of the interviewees played computer or video games on a daily basis (48.7%, n=19). Eighty percent (n=32) of the interviewees had played WolfQuest more than 10 times.

Table 4: How often do you play computer or video games?

Response Category	Percent
Everyday	47.5% (n=19)
4-6 times a week	35.9% (n=14)
1-3 times a week	12.8% (n=5)
Less than once a week	2.6% (n=1)

IV. Results

A. Interest & Attitudes

Web survey participants were asked "Having played this game, now how would you rate your interest in wolves?" The response choices ranged from 1 equaling very much less interested to 5 equaling very much more interested. Over three-quarters (78.2%) of the participants reported an increase in interest in wolves after playing WolfQuest. The majority (55.5%) reported they were "very much more interested in wolves," the highest category available.

Table 5: Having played this game, now how would you rate your interest in wolves?

1 - Very much less interested	2 - Slightly less interested	3 - Feel the same	4 - A little more interested	5 - Very much more interested
0.5% (n=5)	0.4% (n=4)	20.9% (n=3)	22.7% (n=214)	55.5% (n=523)

These increases were most pronounced in the under 18 age categories. The differences in post interest based on age were statistically significant (x^2= 88.69, p<.000, df=39) suggesting that age was a factor in participant change in interest in wolves after playing the game. Other independent variables that were statistically significant included the number of times an individual played WolfQuest, and how often they played computer or video games.

Respondents also demonstrated an increased sense of importance of wolf habits after playing the game, with nearly half of the respondents responding strongly that the game increased their view of the importance of wolf habitats.

Table 6: Did this game change your idea of the importance of wolf habitats like Yellowstone?

1-Very much less important	2-Slightly less important	3-Feel the same	4-A little more important	5-Very much more important
0.5% (n=5)	0.1% (n=1)	24.1% (n=227)	25.5% (n=240)	48.7% (n=469)

B. Greater Connection to Wolves

Individuals playing WolfQuest also reported a stronger emotional attachment to wolves after playing the game. Over three-quarters (75.6%) of the respondents felt the game made them more emotionally connected to wolves. Emotional connection had a statistically significant negative correlation with incoming self-ranked knowledge, so that individuals who ranked themselves as experienced or expert were less likely to report that WolfQuest increased their connection to wolves. This is an expected finding, as these individuals were likely to feel highly connected to wolves prior to playing the game.

Table 7: Post WolfQuest connection to wolves by incoming knowledge level

1-Novice	2-Beginner	3-Intermediate	4-Experienced	5-Expert	Overall
75.0% (n=36)	85.7 % (n=150)	79.3% (n=257)	70.4% (n=205)	61.9% (n=65)	75.6% (n=713)

As one ten year old, self-ranked as an incoming novice, said when asked why s/he felt more connected to wolves, "I know more about them, I used to think wolves were mean and ugly from movies, but now I know what they are like and I feel more like I can help them to survive in this world."

C. Increased Knowledge

Self-Reported Knowledge

In the web survey, we asked individuals to self-rate their knowledge of wolves, their behaviors, and their habitats prior to playing WolfQuest. A significant number of individuals (42%) rated their wolf knowledge as experienced or expert, but as a whole, the rating for pre-knowledge fell along a relatively normal distribution curve. Statistical testing of independent variables did not show any significant differences with age, amount of WolfQuest play, gamer typology, amount of gaming, or zoo visitation. This suggests other factors may have a greater influence on participant's prior knowledge of wolves, behaviors and habitats.

Table 8: Self-rated prior wolf knowledge

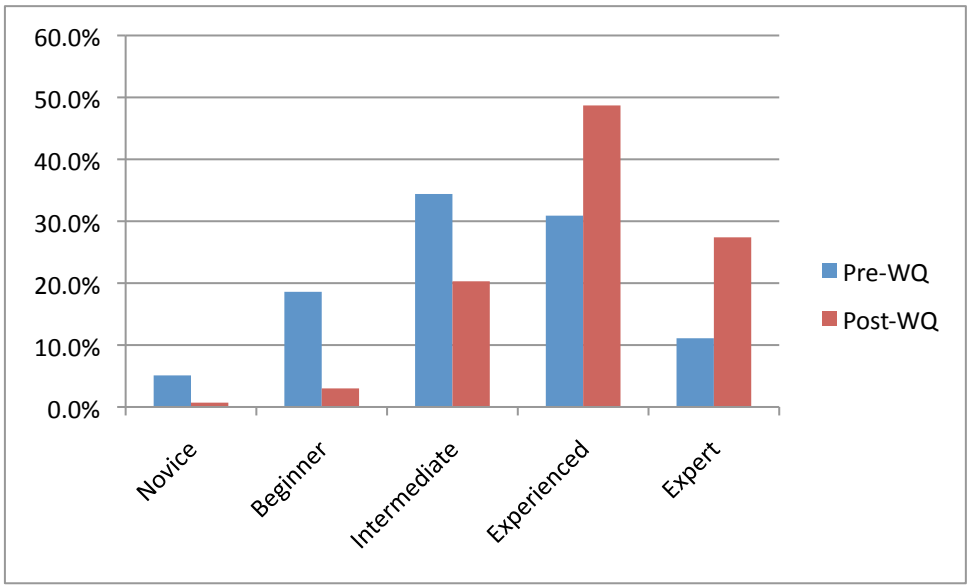
1-Novice	2-Beginner	3-Intermediate	4-Experienced	5-Expert
5.1% (n=48)	18.6% (n=175)	34.4% (n=324)	30.9% (n=291)	11.1% (n=105)

We also asked players to self-rate their knowledge of wolves, their behaviors and their habitats *after* playing WolfQuest. There was a noticeable cognitive gain with a median change score of 1 point on a 5 point scale. (x^2= 295.66 P<.000, df=4; std. dev.=0.784). (See Table 9 and Chart 1.)

Table 9: Self-rated post WolfQuest wolf knowledge

1-Novice	2-Beginner	3-Intermediate	4-Experienced	5-Expert
0.7% (n=7)	3% (n=28)	20.3% (n=191)	48.7% (n=459)	27.4% (n=258)

Chart 1: Self-rated knowledge of wolves, behaviors and habitats



Actual Knowledge

Individuals did not simply claim higher knowledge. WolfQuest had an impact on the learning of the majority of players (n=182) as evidenced by both specific and general recall of facts and knowledge. (See Table 10.) We asked participants a variety of questions about wolves, including what specifically they had learned about wolves from the game. Participants provided a range of up to five responses related to habitats, hunting behaviors, territories and threats to wolf survival, social behaviors, and other wolf facts related to the anatomy and species of wolves. Out of a representative subsample of individuals who took the survey (n=280), 198 individuals responded to this open-ended question. Only 3% of those respondents indicated that they did not learn anything new from playing the game.

Table 10: What are some things you learned, or found out, about wolf behaviors and habitats from playing this game?

Response Category	Percent (n=182)
Social Behaviors	116.0% (n=217)
Hunting	79.1% (n=148)
Defense/Territory	45.5% (n=85)
Other Wolf Knowledge	46.0% (n=86)
Habitat	18.7% (n=35)
Affective/Experiential/Social/Behavioral	13.4% (n=25)
Humans (of and related to)	2.1% (n=4)

*Percentages total more than 100% due to multiple responses, 3.2 responses on average

Sample responses to this question include:

> *"Hunting is actually quite difficult. Wolves have to contend with other predators. Wolves don't always eat their entire kill."*
>
> *"Aggressive behavior varies from pack to pack. Taking down an elk alone is hard. Grizzly bears are a big threat to wolves. Howling can call your mate to you. Wolves are good jumpers."*
>
> *"Wolves are very social. They need large hunting grounds."*
>
> *"Wolves have to eat alot in order to live. Look for weak prey. Don't mess with Grizzlies. Wolves must travel far to survive. A wolf can survive on an elk for days."*

Complexity of Thought

Participants were first asked to rate how good or bad they thought it was for wilderness areas, like Yellowstone park, when wolves hunted within them. They were then asked to explain their answer. From the subsample, 233 participants provided an explanation for their rating. Only 9% (n=20) of all of the responses were off topic, or not related to the actual question. The other 91% (n=213) of the subsample provided on-topic responses that ranged from simple to complex.

Those who felt that "Hunting was good for Yellowstone" focused on the following themes, primarily ecosystem related:

- balanced ecosystem and natural food chain
- population control for prey groups
- prevents wolf species from becoming extinct
- improves the health of prey herds by killing the weak and old
- saves them from the threat of humans

Responses in this category included:

> *"Because for one thing, it keep them alive, helps them survive, and keep the natural ecosystem in good balance. For example, if wolves didn't hunt the weak elk, disease could spread and the elk population could die out."*
>
> *"Wolves exist to help keep nature in balance. They keep prey animals strong by hunting the old the weak."*
>
> *"Wolves take down the weak prey, which makes the prey species stronger, feeds the wolves and others such as coyotes, foxes, birds, right down to bacteria. Without wolves, prey species would overgraze areas leading to habitat destruction. Wolves are a part of…"*

Those individuals who felt hunting was bad focused on a concern for the loss of other populations and species at Yellowstone, such as the individuals who stated, "Elk might decrease in numbers."

Those respondents who noted that hunting was neither good nor bad considered both the prey and the predator and the various roles they played in the ecosystem. Responses tended to emphasize the importance of all species at Yellowstone, such as the individual who stated, "I think that wolves hunting, when their numbers are in a good ratio to their prey, its part of the natural system so its neither bad nor good. It just is."

D. Behavior Change

Within the scope of the Web survey, we asked players what sort of activities and behaviors they engaged in as a result of their WolfQuest experience. Behavior change is a notoriously difficult outcome to achieve and measure for many projects, therefore the web-based questionnaire was designed to solicit both actual activities and the intention to do those activities; followed by telephone interviews to parse the difference between actual and intended behaviors and distinguish any over reporting (Friedman, 2008).

Overall, large percentages of players showed extremely high intentions or actual reports of doing other wolf-related activities, including such further explorations of wolves on the Internet, in books and on television. (See Table 11.)

Table 11: Due to playing WolfQuest, have you done or do you intend to do any of the following…. (Web-based questionnaire data)

Response	Percentage
Look up information about wolves on the Internet?	84.2% (n=797)
Watch a TV show or video about wolves?	83.8% (n=792)
Read about wolves in books, magazines, or newspapers?	82.6% (n=781)
Talk to friends or family about playing the game?	82.2% (n=778)
Talk to friends or family about wolves?	78.4% (n=742)
Make art related to wolves?	76.3% (n=722)
Visit a zoo?	72.5% (n=686)

Visit a nature center, state park, or wilderness area to see wildlife?	69.3% (n=656)
Participate in outdoor activities, such as hiking, fishing, birdwatching, etc.?	67.0% (n=634)
Visit a wildlife area to see wolves?	62.3% (n=589)
Write something about wolves or wolf habitats?	58.7% (n=555)
Create a wildlife friendly backyard garden?	42.2% (n=399)
Plan a school project related to wolves?	41.1% (n=389)
Attend a wolf class or program at a zoo or nature center?	38.4% (n=363)

Over three-quarters of the participants indicated that they actually had or intended to look up information about wolves, watch videos or television shows about wolves, read further about wolves, make art about wolves and talk to friends and family about wolves and the WolfQuest game specifically. Over half of the individuals connected playing WolfQuest with their increased visits or desire to visit zoos, nature centers and state parks and to participate in outdoor activities.

The commentary from the players when asked to list any other activities they had done due to WolfQuest demonstrated their deep connection to the game. Table 12 below shows just some of a broad range of detailed and complex responses to this question (and includes age and incoming self-rated knowledge level). The variation in incoming knowledge level shows that even those individuals who considered themselves to be "beginners" in terms of wolf knowledge before playing the game aspired to, or had already engaged in, significant activities and expressions of values about wolves as a result of the game.

In addition, the more an individual played the game, the more likely s/he was to report doing or intending to do the above behaviors. Only two activities—creating a wildlife friendly backyard garden and visiting a nature center, state park, or wilderness area to see wildlife—did not show statistically significant differences between casual players and those that played WolfQuest more than ten times.

Table 12: What Other Wolf Activities Have You Done Due to Playing WolfQuest? (Web Survey)

Responses	Age	Incoming Knowledge level
Made paper wolfs. And I like acting like one in my yard.	7	3
I've made up a wolf game with my friends at school	9	1
I'm planning to clean up forests and make it a better home	10	4
Fund raiser	10	2
Pretend to be a WOLF on the nature trail!	10	4
I colored pictures of wolves from books	10	2
I have planned to visit the Minnesota zoo and go to Yellowstone National Park.	10	1
I might go to Ely, MN to the International Wolf Center this summer!!!!!!!!!!	10	3
I have seen the world the way wolves do.	10	0

I plan to convince the world (or neighborhood for now) that wolves are not mindless animals but are beautiful and magnificent creature, I also am making a petition to stop the killing of wolves and to start building wolf habitats.	10	2
I plan to go to Yellowstone next summer with my best friend who also loves wolves and plays WolfQuest.	10	3
Make a website about them	10	4
Wolf for Halloween, painted a picture, watched a documentary	10	2
Tried to raise money for wolves by making little boxes saying "save a wolf £1"	11	2
I am planning to put posters up around my school about WQ	11	1
Go camping in the wilderness maybe	11	1
Talk about wolves (I talk A LOT by the way)	11	1
I draw pictures of myself in the game. (I am a pure white wolf called Mist)	11	2
"Adopt" a wolf and support it in the wild	11	4
I started keeping a journal about the elk population in Yellowstone.	12	3
I am planning to help wolves by donating to my local zoo and getting others to, also, because I think wolves are a great educational animal.	12	3
My family and I went to Yellowstone over the summer, and I was able to see the areas that the game is based in (Slough Creek, Specimen Ridge, Druid Peak, Lamar Valley, etc.)	13	1
I talked to Dave Mech (a biologist) about the game and correspondingly about the Yellowstone wolf project	13	3
I have redecorated my bedroom so it is completely about wolves.	13	3
Raised Money for Wolves through a lemonade stand	13	0
I've signed up for a voluntary job at an injured wolf rehabilitation center.	13	3
Well I did a speech on why they should not shoot wolves in Alaska... my class loved it and so did my teacher.	14	1
Go to a wolf center like here in Colorado or in Mission: Wolf. Guess what? We now have wolves in the four-mile area! So close to me! I heard them howl! I'm so EXCITED!	14	3
I wrote a speech about the yellow stone wolves for debate and will be taking it to competitions.	15	3

*Scale on incoming knowledge is 1-5, with 1 representing novice and 5 representing expert.

As the reports of actual and intended behavior due to playing WolfQuest were extremely high, one of the primary goals for the telephone interviews was to gauge how much of the behaviors reported were actual and how much were intentions for behaviors that had not yet occurred. As can be seen in Table 12, the telephone interviews provided evidence that WolfQuest players were actually carrying out intended behaviors due to their WolfQuest playing. Some of these behaviors took the form of subsequent activities that would reinforce the knowledge learned and connections gained, such as talking to friends and family and searching out further information and knowledge. Other behaviors related more directly to experiencing science and nature, such as visiting a zoo and participating in outdoor activities.

Table 13: Due to playing WolfQuest, have you done or do you intend to do any of the following…. (Telephone interview data)

Behavior Statement	Actual (Has done this since playing game)	Intended (Plans on doing this because of playing game)	Can not or will not do this
Talk to friends or family about playing the game	97.5% (n=39)	2.5% (n=1)	0% (n=0)
Talk to friends or family about wolves	82.5% (n=33)	12.5% (n=5)	5% (n=2)
Look up information about wolves on the Internet	77.5% (n=31)	12.5% (n=5)	10% (n=4)
Watch a TV show or video about wolves	72.5% (n=29)	22.5% (n=9)	5% (n=2)
Make art related to wolves	72.5% (n=29)	2.5% (n=1)	25% (n=10)
Read about wolves in books, magazines, or newspapers	57.5% (n=23)	20% (n=8)	22.5% (n=9)
Plan a school project related to wolves	50% (n=20)	20% (n=8)	30% (n=12)
Write something about wolves or wolf habitats	47.5% (n=19)	12.5% (n=5)	40% (n=16)
Participate in outdoor activities, such as hiking, fishing, birdwatching, etc.	40% (n=16)	30% (n=12)	30% (n=12)
Visit a nature center, state park, or wilderness area to see wildlife*	40% (n=16)	40% (n=16)	17.5% (n=7)
Visit a Zoo*	27.5% (n=11)	50% (n=20)	20% (n=8)
Visit a wildlife area to see wolves*	15% (n=6)	60% (n=24)	22.5% (n=9)
Create a wildlife friendly backyard garden	15% (n=6)	35% (n=14)	50% (n=20)
Attend a wolf class or program at a zoo or nature center	7.5% (n=3)	65% (n=26)	27.5% (n=11)

*Some rows may not add up to 100% due to missing data.

Correlations with Behavior

Statistical analysis of behavior change data in the web-based questionnaire showed that evidenced (or intended) behaviors had a number of correlations with independent variables. Table 14 shows an overall summary of the statistically significant positive correlations (noted with an asterisk).

The main three independent variables that correlated with increased outcome behaviors were age, gamer type, and amount of WolfQuest play. Age had a strong correlation, as younger players were more likely to show behavioral change than older ones. The amount an individual played WolfQuest also correlated strongly with behavior change, such that individuals who played more became more likely to exhibit the sought after behaviors.

Interestingly, incoming knowledge did not strongly impact behavior, except in the case of looking up information on the Internet and watching television or videos related to wolves. While incoming knowledge was not correlated with change, prior interest in wolves was.

Although game players who considered themselves "Explorers" or "Socializers" on Bartle's typology were more likely to engage in outcome-related behaviors, these correlations are less reliable than the ones mentioned above for two factors. First, we did not implement the full set of questions from Bartle's typology; secondly the overwhelming number of individuals who identified themselves as Explorers or Socializers means that the cell size was very close to violating statistical assumptions.

Table 14: Correlations with Behavior

Response	Age	Prior interest in wolves	Incoming Knowledge	Amount of Video Game Play	Gamer Type	Amount of WQ play	Zoo Visit
Look up information about wolves on the Internet?				*		*	
Watch a TV show or video about wolves?			*	*	*		
Read about wolves in books, magazines, or newspapers?	*		*		*	*	*
Talk to friends or family about playing the game?	*				*	*	*
Talk to friends or family about wolves?		*			*	*	*
Make art related to wolves?	*	*			*	*	
Visit a zoo?	*	*		*	*		
Visit a nature center, state park, or wilderness area to see wildlife?		*			*		*
Participate in outdoor activities, such as hiking, fishing, birdwatching, etc.?	*	*			*	*	*
Visit a wildlife area to see wolves?		*				*	*
Write something about wolves or wolf habitats?	*	*			*	*	
Create a wildlife friendly backyard garden?		*			*	*	
Plan a school project related to wolves?	*	*		*	*	*	
Attend a wolf class or program at a zoo or nature center?		*			*	*	*

E. Scientific Habits of Mind

One of the original evaluation questions regarding WolfQuest was regarding the use of critical thinking skills throughout the game. James Gee, in his book *What Video Games Have To Teach Us About Learning and Literacy* (2003), is one of the more prominent voices to argue that video gaming playing can reinforce a variety of learning principles. As Gee states, "[Games] operate with – that is, they build into their designs and encourage – good principles of learning." There is some overlap between Gee's 36 principles of learning and the collection of skills known as scientific habits of mind. For instance, Gee discusses a Probing Principle, which he defines as *"Learning is a cycle of probing the world (doing something); reflecting in and on this action, and on this basis, forming a hypothesis; reprobing the world to test this hypothesis; and then accepting or rethinking the hypothesis."*

In designing the summative evaluation, we choose the more specific framework of scientific habits of mind as a basis for the analysis, as described by American Association for the Advancement of Science (AAAS)'s *Benchmarks for Science Literacy* (1993, 2009). Project 2061 asserts that one of the main goals

of schooling is skill-building, to create a citizenry that are more effective problem solvers. Project 2061 suggests a domain of skills including quantitative, communication and critical-response skills that are crucial for science literacy. This domain, called scientific habits of mind, is positioned as more general than problem-solving skills but more specific than critical thinking skills.

Steinkuehler and Duncan (2008), researchers in gaming and learning, have applied the concept of scientific habits of mind (including, for example, model-based testing, social construction of knowledge, and use of evidence) to the commercial massive multi-player online game World of Warcraft *(*WoW), studying how the game forums might show evidence of this particular skill set. Their study analyzed a random sample of 1984 posts across 85 threads of 4656 threads total, including discussion posts made by 1087 unique WoW characters. For WolfQuest, we took the rubric that Steinkuehler and Duncan created and adapted it for use in this setting. (Our coding rubric is included in Appendix C and includes examples from the web survey data.) Our study differs from theirs in a number of ways. First, the primary audience of WoW is adults, whereas WolfQuest focuses on children and teens. Consequently, we see less depth in the individual discussions than in the WoW study, where individuals posted entire sets of calculations in spreadsheets to justify their positions.

Secondly, we applied their rubric in three different ways across our methods. First, we asked web survey respondents how they solved with challenges they encountered in the game. We asked this question again of those same respondents in the context of playing in multiplayer mode. Finally, and most similar to the Steinkuehler and Duncan paper, we coded a random subsample of 321 threads from the "Tips, tricks and help" forum comprising of 2,834 posts (average of 8.83 posts per thread).

In the web survey data (Table 15), participants showed some evidence of scientific habits of mind in use; though nearly half of the responses did not specify specific habits, but instead indicated some function of trial and error. We classified responses as trial and error when we were unable to determine whether their repeated attempts were based on revising a strategy or less thoughtfully repeating variation until the result changed. In a physical museum setting, one might see the same sort of difference between those visitors who try an interactive and then, when the result is not apparent or appropriate, revise their strategy, compared to visitors who bang on interactive buttons randomly until something happens. If we were unable to determine whether there was intent or strategy in the repetition, we coded it as trial and error. This type of response may be due to a mismatch in rubric and question type, or may relate to the level of sophistication in response the target audience was prepared to give.

Table 15: Web Survey analysis for scientific habits of mind

Category	Frequency
Trial and error	43.93% (n=94)
Model based reasoning, testing and prediction	15.42% (n=33)
System based reasoning	14.02% (n=30)
Understanding feedback	7.94% (n=17)
Collects/Uses data/evidence (explicitly) Alternative explanations of data	6.54% (n=14)
Mathematical modeling and computation	6.54%(n=14)
References outside sources	6.07%(n=13)

Builds on others ideas	2.34% (n=5)
Social Knowledge Construction	>1% (n=2)
Use of counter arguments	>1% (n=2)

They made predictions about what hunting and mate-finding strategies might work, tested those predictions, analyzed the results, using observation and note-taking skills, and collaborated with others to devise new techniques. All of these responses supported the extensive, systematic use of scientific habits of mind throughout the playing of WolfQuest. When asked how they solved problems, participants in the web-based questionnaire bolstered the forum findings with statements such as:

> *"Well, at first, I was a very terrible hunter. I mean. I was pitiful. I couldn't even take down the weakest elk in the herd, even WHEN I had a mate! It was a very sad sight to see. Well, to overcome such a problem, I just kinda practiced. And watched a few videos that people had made. And... Well, I made a few observations myself. And you know what... it worked! I kinda just practiced, watched my status bars and stuff, took notes."* [Collects and uses evaluation, References outside resources (videos)]

> *"I had to overcome speed, and the trouble with the social behavior. I also had to keep up with hunting, and trying not to die. Survival of the fittest. I tested being dominant over the stranger wolves, and how to save energy for hunting. Once I found a mate, everything got easier and more easier."* [Model-based reasoning, testing and prediction]

> *"To use the right body language to kill/ make friends with other wolves. Knowing which reply to make is important—never give the other wolf a chance to attack. Hunting elk—never run full charge willy-nilly at the whole herd. Wait until one is separate. Try different things and record what data worked best."* [Collects and uses data]

Some players used the multiplayer mode specifically to address game challenges.

> *"Well, I also took a bunch of information and tips from my friends. I watched them hunt the elk, and saw their strategies. And combined them, along with what I saw on the videos and from my own observations, together to make my own awesome strategy to hunt."* [Social knowledge construction, collects and uses data, uses outside resources, systems-based reasoning]

The data we analyzed from the WolfQuest forum differs in style and tone from the web survey data. The web survey data represents responses to direct questions, whereas the forum data are online posts which we have culled to analyze. Even though 78.3% of those answering the web survey had visited the forums at some point, social knowledge construction did not show up as a primary habit of mind.

Participants of the tips, tricks and help forum are generally seeking help to advance their game play, such as this individual:

> *"I was trying out the demo and I couldn't figure out how to mark my territory like in the trailer. Any hints?"*

In the forum data but not the web survey data, we can also see use of arguments and counter-arguments:

"Okay but why dose [sic]*it say when you run from a wolf it says you lost your territory and if you make a wolf run away something appears really fast that says the word home at the end? (I think)"*

Response: *"Since when you scare it away, it does not gain land either. So I guess you're defending land either way."*

"Yes, they do show. But it seems still after a period of time, or after you've done something they tend to turn invisible"

In the analysis of forum postings, respondents showed evidence of scientific habits of mind throughout their responses. (See Table 16.)

Table 16: Forum analysis for scientific habits of mind

Category	Frequency
Social Knowledge Construction	19% (n=534)
Builds on others ideas	18% (n=520)
Use of counter arguments	12% (n=343)
Collects/Uses data/evidence (explicitly) Alternative explanations of data	3% (n=91)
References outside sources	3%(n=76)
System based reasoning	2% (n=51)
Mathematical modeling and computation	1%(n=35)
Understanding feedback	<1% (n=12)
Trial and error	<1% (n=7)
Model based reasoning, testing and prediction	<1% (n=1)

Understandably due to the social nature of the forum, the social aspects of scientific habits of mind, such as social knowledge construction, building on others' ideas, and use of counter arguments are the most common habits seen here.

V. Conclusions and Implications

Though the debate over learning games continues in the popular press, this evaluation presents evidence that a game can impact STEM learning. The WolfQuest game, website, and community forums have a strong demonstrated ability to achieve the sought-after outcomes for the targeted audience:

- increased knowledge of wolf behaviors and ecology;
- increased interest and positive attitude towards wolves and their habitats;
- increase intended or actual wolf-related conservation behaviors; and
- supported or reinforced scientific habits of mind.

Reach was strong; players were the target audience

Several items are notable about the WolfQuest project. First, the game reach alone has been significant. About 4,000 users downloaded the game in the first few hours after launch and over 350,000 people have downloaded the game in the 21 months since it launched. On average, players engage in over 100,000 multiplayer game sessions per month. The game's online community has over 80,000 registered members who have made over 850,000 posts to the forum, with a current average of 1,400 posts daily. Secondly, despite the fact that WolfQuest was a downloadable game available to anyone, the game achieved reaching its target audience of 9-15 year olds, with nearly 70% of players coming from that age range.

Interest in & knowledge about wolves increased

Data collected for the summative evaluation shows that player interest in, connection to, and knowledge regarding wolves, their behaviors, and their habitats has increased significantly. This is despite the fact that STEM-content knowledge was woven throughout the game and rarely, if ever, explicitly "taught". Over half of the survey participants rate their interest in wolves a "5", the highest response option category. Individuals playing WolfQuest also report a stronger emotional attachment to wolves after playing the game. Over three-quarters of the respondents feel the game made them more emotionally connected to wolves. Emotional connection has a statistically significant negative correlation with incoming self-ranked knowledge, so that individuals who rank themselves as experienced or expert were less likely to report that WolfQuest increased their connection to wolves.

In self-reported knowledge, there is a definite cognitive gain with a median change score of 1 point on a 5 point scale. In open-ended questions, over 90% of respondents could name either general or specific items they learned, including facts related to habitats, hunting behaviors, territories and threats to wolf survival, social behaviors, and other wolf facts related to the anatomy and species of wolves.

Evidence of transfer of interest and knowledge into behavior

After playing WolfQuest, players continue with other wolf-related learning and behaviors. Over three quarters of the survey either actually or intended to look up information about wolves, watch videos or television shows about wolves, read further about wolves, make art about wolves and talk to friends and family about wolves and the WolfQuest game specifically. Over half of the individuals connect playing WolfQuest with their desire to visit zoos, nature centers and state parks and to participate in outdoor activities.

Younger kids who played more exhibited more subsequent behaviors

Overall, age was a strong contributing factor, as younger players are more likely to show behavioral change than older ones. Incoming knowledge does not strongly impact behavior, except in the case of looking up information on the Internet and watching television or videos related to wolves. While incoming knowledge is not correlated with change, prior interest in wolves was. The amount an individual plays WolfQuest is also correlated with behavior change, with individuals who played more being more likely to exhibit the sought after behaviors.

Scientific habits of mind were evidenced in game play

WolfQuest players showed the use of scientific habits of mind, including model-based testing, social construction of knowledge, and use of evidence in their problem-solving and discussions around problem-solving. While this finding corroborates findings elsewhere in current gaming research, it is notable in that it demonstrates these skills at a younger level and within the context of a learning game.

Throughout the evaluation, WolfQuest was shown to be a highly effective in achieving its goals and providing a rich and rewarding learning experience for the players. While this was an evaluation of a particular game, rather than a research study of STEM-related gaming, it raises several topics for future potential research.

Future Research Potential

1. Which elements of the WolfQuest game are most crucial for encouraging STEM-learning?

The WolfQuest game is an action/role-playing simulation game that is supported by a website and a large community forum. While we can hypothesize that the community forum encouraged replay and reinforced the knowledge gained, there is no way to determine the relative contribution of the forums to the audience outcomes. Similarly, the content matter (wolves) was a good fit for both an action game and for action/role-playing. Would other types of games on other STEM content matter show similar outcomes?

2. Can scientific habits of mind be taught, as well as reinforced, in game-play?

This evaluation substantiates the findings of Steinkuehler and Duncan (2008) that evidence of the use of scientific habits of mind can be seen in analysis of conversation surrounding game play. While other games exist that encourage the development of critical thinking skills (most notably Quest Atlantis), there is still not enough research into whether games that are distributed online and not played within a facilitated situation (such as in a program or afterschool setting) can actual increase the use of scientific habits of mind or STEM-related critical thinking skills. And if so, what elements of these games are central to the development of these skills? Given the reach and potential of these games, more research is needed.

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Appendix A: Web-based Survey

WolfQuest Needs Your Feedback!

WolfQuest is doing a study to understand more about your experience visiting the website and playing the game, as well as your thoughts on wolves in general. Please take a few minutes to help us with our survey.

Some things you should know before you start:
We really want to hear your thoughts about WolfQuest. It's O.K. if you haven't played the game very much or even if you didn't like it. We want to hear **all perspectives**, so share what you thought, no matter what your views.

No information will be gathered which could identify you personally, and anything you say will be kept strictly **confidential, safe, and monitored** by us (Kate & Jes, the WolfQuest research team).

This survey should only take about 8-10 minutes. If you need to stop and come back to the survey later, click on the link in your email invitation to start where you left off. Your responses will only be submitted after you click the **Submit** button at the end of the survey.

1) Which of the following activities have you done while visiting the WolfQuest website (www.wolfquest.org)? (Please answer 'No' or 'Yes' to each activity)

Have you…

	No	Yes
Downloaded the WolfQuest game?	❍	❍
Visited the "About Wolves" section of the website?	❍	❍
Clicked on links to visit other WolfQuest partners such as Yellowstone National Park or the Phoenix Zoo?	❍	❍

2) Have you visited the WolfQuest "Community" forum on the website?

❍ No
❍ Yes

3) Which sections of the WolfQuest "Community" forum have you gone to? (Please answer 'No' or 'Yes' to each activity)

I went to the…

	No	Yes
"Talk about the game" section	❍	❍
"Talk about wolves" section	❍	❍
"The wild and you" section	❍	❍
"Other topics" section about other games or topics	❍	❍

4) While you were visiting those sections of the Community forum, which of the following things did you do? (Please answer 'No' or 'Yes' to each activity)

I…

	No	Yes
Read some of the posts	❍	❍
Became a registered user of the forum	❍	❍
Wrote or responded to a topic	❍	❍
Uploaded images or other content about wolves to the site	❍	❍

5) Have you played the WolfQuest game?

❍ No
❍ Yes

6) What are some things you learned, or found out, about wolf behaviors and habitats from playing this

7) In your opinion, what does a wolf need in order to survive in the wild?

(List as many things as you can)

Please describe:

8) When wolves hunt, how good or bad do you think it is for wilderness areas like Yellowstone National Park?

- ❍ 1-Very bad
- ❍ 2-Bad
- ❍ 3-Borderline
- ❍ 4-Good
- ❍ 5-Very good

9) Why do you think that? Please explain:

10) On average, how much of the time do you think wolves in Yellowstone are successful at hunting?

- ❍ 5% of the time
- ❍ 20% of the time
- ❍ 40% of the time
- ❍ 60% of the time
- ❍ 80% of the time
- ❍ 100% of the time

11) Under what conditions are wolves most likely to be successful at hunting?
Please describe:

12) <u>Before</u> you ever played WolfQuest, how would you have rated your knowledge of wolves, their behaviors, and their habitats?

- ❍ 1-Novice
- ❍ 2-Beginner
- ❍ 3-Intermediate
- ❍ 4-Experienced
- ❍ 5-Expert

13) <u>After</u> playing WolfQuest, how would you now rate your knowledge of wolves, their behaviors, and their habitats?

- ❍ 1-Novice
- ❍ 2-Beginner
- ❍ 3-Intermediate
- ❍ 4-Experienced
- ❍ 5-Expert

14) There are certain challenges or problems to solve in any game. What were the <u>challenges</u> you had to overcome to be good at this game? Please describe:

15) How did you test what would work to <u>overcome those challenges</u>? Please describe:

16) Did you play any multiplayer games to overcome challenges in the game?

- ❍ No
- ❍ Yes

17) <u>How</u> did you work in multi-player mode to overcome those challenges?
Please explain:

18) Did playing WolfQuest make you feel more emotionally connected to wolves than before you played it?

- ❍ No
- ❍ Yes

19) Why do you think that? Please explain:

20) Having played this game, how would you now describe your interest in wolves?

- ❍ 1-Very much less interested
- ❍ 2-Slightly less interested
- ❍ 3-Feel the same
- ❍ 4-A little more interested
- ❍ 5-Very much more interested

21) Did this game change your idea of the importance of wolf habitats like Yellowstone? If so, how much?

- ❍ 1-Very much less important
- ❍ 2-Slightly less important
- ❍ 3-Feel the same
- ❍ 4-A little more important
- ❍ 5-Very much more important

22) As a result of playing WolfQuest, did you, or do you plan to, do any of the following activities? (Please answer 'no' or 'yes' for each activity)

Did you, or do you plan to...

	No	Yes
Talk to friends or family about playing the game?	❍	❍
Talk to friends or family about wolves?	❍	❍
Look up information about wolves on the Internet?	❍	❍

Read about wolves in books, magazines, or newspapers?	❍	❍
Watch a TV show or video about wolves?	❍	❍
Write something about wolves or wolf habitats?	❍	❍
Make art related to wolves?	❍	❍
Visit a zoo?	❍	❍
Participate in outdoor activities, such as hiking, fishing, birdwatching, etc.?	❍	❍
Plan a school project related to wolves?	❍	❍
Visit a wildlife area to see wolves?	❍	❍
Attend a wolf class or program at a zoo or nature center?	❍	❍
Create a wildlife friendly backyard garden?	❍	❍
Visit a nature center, state park, or wilderness area to see wildlife?	❍	❍

23) What other wolf-related activities have you done or plan to do as a result of playing WolfQuest? Please describe:

24) Was this your first time playing WolfQuest?

❍ No
❍ Yes

25) How many times have you played WolfQuest before today?

❍ Once or twice
❍ 3-5 times
❍ 6-10 times
❍ More than 10 times

26) When you play, do you normally play single-player or multi-player mode?

❍ Single-player mode
❍ Multi-player mode

27) Which of the following statements <u>best describes</u> how you play computer or video games, in general?

When I play…

❍ I am most interested in mastering the game and scoring the most points.
❍ I am most interested in discovering new parts of the game and creative ways to advance through it.
❍ I am most interested in getting to know other people like me who play the game.
❍ I am most interested in attacking as many other players as possible.

28) On average, how often do you play computer and/or video games?

❍ Less than once a week
❍ 1-3 times a week
❍ 4-6 times a week
❍ Everyday

29) Have you <u>visited a zoo</u> with friends or family for any reason other than on a school field trip <u>in the last two years</u>?

❍ No
❍ Yes

30) And finally, how old are you?

_____years old

31) In which country do you live?

[Response options: All countries.]

32) If you are from the United States, which state do you currently live in?

[Response options: All states.]

You're finished! Thank you so much for taking the time to share your thoughts with us. It's a huge help!

Appendix B: Telephone Interview

WolfQuest Remote Intercept Semi-Structured Interview

Instrument Goals:

- To unpack user intentions versus actual behaviors related to wolves and conservation
- To collect qualitative information to enrich the web survey data related to prior interest and change in interest
- To better understand problem solving strategies game players used
- To capture questions that were not suitable for the web survey (i.e. preservation)
- Not looking for more cognitive or affective information

Interview (behavior, prior interest, problem solving, preservation)

Intro

Hi! This is Jes/Kate/Victor from the WolfQuest survey you recently filled out indicating your interest in helping us with our research study. We're helping the game developers better understand the people who are playing their game. (If under 18) Before we get started I just need to speak with your parent or guardian to make sure they think it is OK for you to participate. (Gain consent).

Great! Thank you very much for your willingness to help us out. I'm going to spend about 10-15 minutes with you today, asking some questions related to your interest in wolves and your experience with the game.

Interest

First I'd like to talk to you about your interest in wolves. On the initial survey (the screener) you indicated that your interest in wolves BEFORE playing WolfQuest was a #X.

1 Now that you have played the game how would you rate your interest in wolves?

(Probe: Did you already love wolves before you played the game? For high level satisficers)

Interviewer deductively code

Are you:

- [match w/screener score of 1&2]-Very much less interested in wolves
- [match w/screener score of 3]-Slightly less interested in wolves
- [match w/screener score of 4]-Do you feel the same about wolves as you did before

- [match w/screener score of 5&6]-Are you a little more interested in wolves
- [match w/screen score of 7]-Or, are you very much more interested in wolves than before?

(Match screener score to code above. If change of interest…)

2 What about the game made you more (or less) interested in wolves?

(*Probe: Tell me more about that.)*

Preservation of Habitats

3 Did playing this game change your idea of the importance of wolf habitats like Yellowstone or other nature areas?

- Yes
- No

4 By how much would you say it changed your idea of the importance of wolf habitats?

Do you think they are:

- Very much less important
- Slightly less important
- (if no above, select) Feel the same
- A little more important
- Very much more important

5 What about the game made you made you think wolf habitats were more (or less) important?

(Probe: Tell me more about that.)

Problem Solving/Scientific Habits of Mind

6 There are certain challenges or problems to solve in any game. What were the challenges you had to overcome to be good at this game, or to accomplish a specific quest?

7 (Follow up) **How did you test what would work to overcome those challenges or problems?** *(Probe: What is the step by step process you went through to think through the challenge?)*

Code after interview using coding rubric for Scientific Habits of Mind

8 (If multiplayer not mentioned) **Did you play any multiplayer games to overcome challenges in the game?**

- Yes
- No

9 (If Yes above or if mentioned earlier) **How did you work in multi-player mode to overcome those challenges?**

(Probe: How did working with other people help you overcome the task or challenge? Tell me more about that.)

Code after interview using coding rubric for Scientific Habits of Mind

Intention vs. Actual Behaviors

10 Finally, we have a list of things related to wolves that you might have done or that you might want to do as a result of playing WolfQuest. I'm going to read them to you one by one. **Can you please tell me if you've already done the activity since playing WolfQuest for the first time, if you plan or intend to do the activity soon, or if you don't think you'll ever really be able to or be interested in it.**

Interviewer ask for examples of activities done or planned to do. Ask why what the reason is for not being interested or able to do an activity. Probe to ensure that each activity is selected as a result of playing the game.

Activity	**Has done**	**Will do**	**Won't do**	**Explanation/Example**
Talk to friends or family about playing the game				
Talk to friends or family about wolves				
Look up information about wolves on the Internet				
Read about wolves in books, magazines, or newspapers				
Watch a TV show or video about wolves				
Write something about wolves or wolf habitats				
Make art related o wolves				
Visit a zoo				
Participate in activities such as				

hiking, fishing, bird watching				
Plan a school project related to wolves				
Visit a wildlife area to see wolves				
Attend a wolf class or program at a zoo or nature center				
Create a wildlife friendly backyard garden				
Visit a nature center, state park, or wilderness area to see wildlife				

11 What other wolf-related activities have you done or do you plan to do as a result of playing WolfQuest?

(Probe: Can you be more specific or give me an example of that activity?)

Thank You

Thanks again for your time and really great thoughts. This information will help the WolfQuest developers create even better quests in the future!