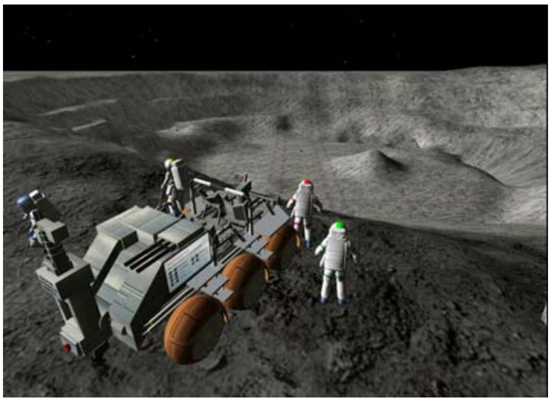
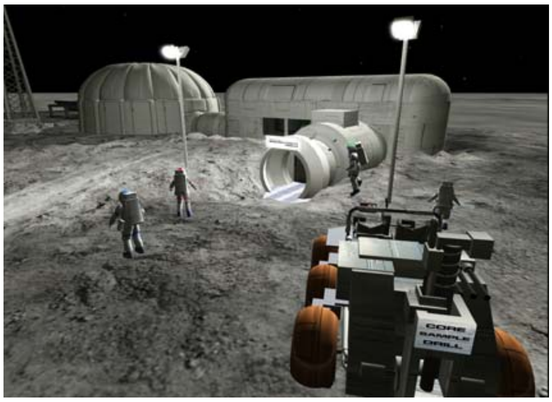
MSc in e-Learning – Introduction to Game-Based Learning – Game Review
Austin Tate – 16th April 2012

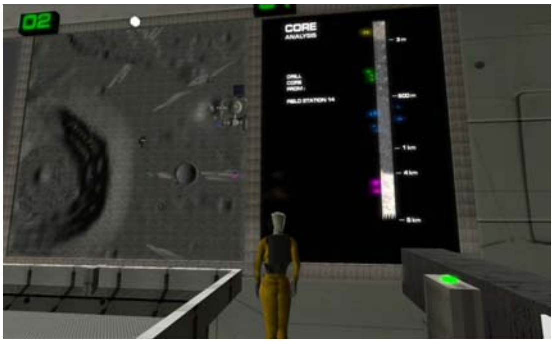
MoonWorld - Virtual Fieldwork for Planetary Geology

MoonWorld (Ruberg et al., 2009) is a space-themed virtual world field trip encouraging the study of rocks and geology in a collaborative learning context. The instructional goals include using evidence gathering and analysis to understand how impact craters form and how their spatial relations with other landforms can be interpreted in terms of the history and stratigraphy.





A group of intrepid explorers journeyed to the surface of the Moon, collected and discussed rock and core samples and the processes which might have led to the formation of the various features. Back at Moonbase, had the sim been working correctly, we would have analysed our samples and understood more of the processes before taking a final questionnaire on our discoveries.



Moon World Game Review and Analysis

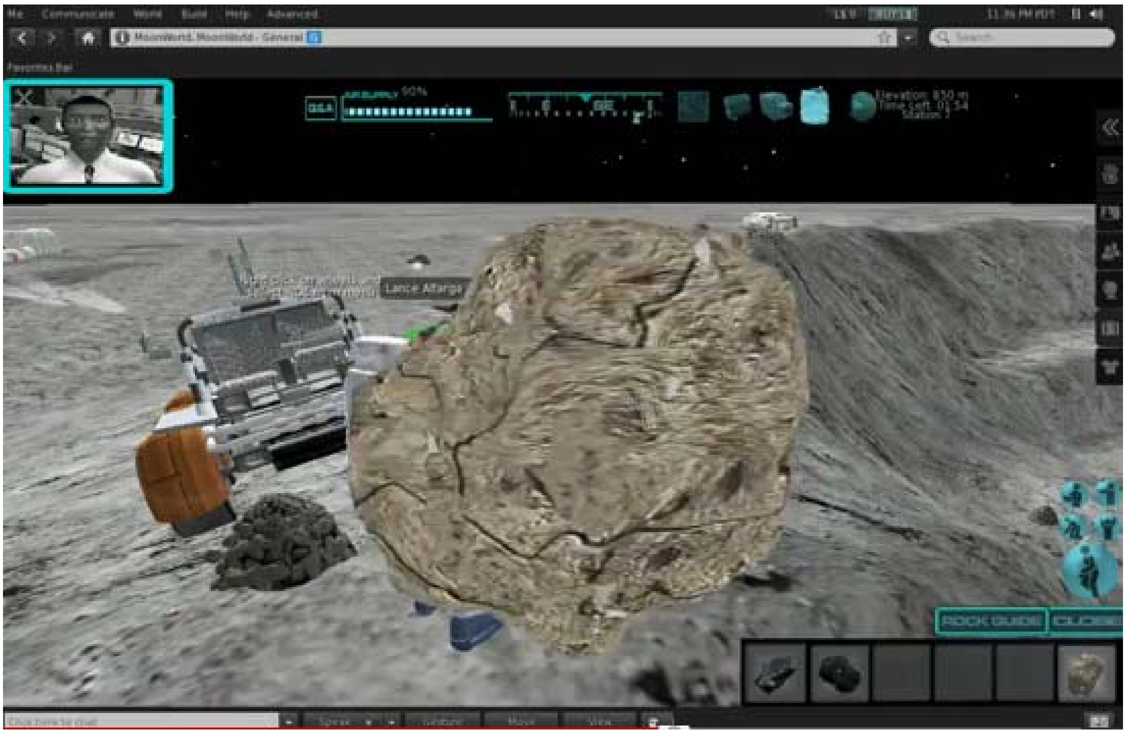
Intrinsic Motivation

Malone (1981) identifies the motivators of challenge, fantasy and curiosity, and all are present in strength in MoonWorld. Malone finds these intrinsic motivations are a key factor in the attractiveness of playing and gaining skills in video games to support educational objectives. Malone found that the presence of goals was the "single most important factor" in determining the popularity of games to players, and there are very clear goals in MoonWorld.

Norman (2002) when speaking about the design of immersive on-line games noted that the intrinsic motivation of curiosity was encouraged by the introduction of various experiences of variable difficulty being sprinkled through the game environment. MoonWorld has a very rich set of such features to maintain the involvement of the player. These include the orbital station preparation process, the landing sequence, air supply management and refills, various surface exploration equipment, a drivable moon buggy, moon base analysis lab, base resupply operations, a return vehicle, and final rewards.

Gradual Introduction of Features

Norman (2002, p.208) also observes that the design of games and their interfaces can lead to difficulties for players which can in turn lead to frustration. Elements of the interface need to be gradually introduced in a playable context to be assimilated well and to be understood for what will follow in the use of the tools. MoonWorld seemed to be exemplary at adding Head-Up-Display (HUD) and tool elements progressively over the first four sample collection stations, so the player is not overwhelmed. These are designed to provide the “scaffold process” (Wood, Bruner, and Ross, 1976; Rogoff, 1998) for the player at various way points – e.g., a grounding in HUD usage, five key features of rocks, terrain type and structure, etc. These are all features that build up to the main exploration events at the featured crater. The experience at each sampling station also allowed for a reinforcing exercise and teacher feedback and support where necessary to enable learners to move quickly to new skills in the sense of them being in a “just right” Zone of Proximal Development (Vygotsky, 1934).



MoonWorld Interface in Second Life – after all HUD elements are introduced

Team Spirit

The social community in which learning takes place can be a good motivator (Malone, 1981). Lave and Wenger (1998) continue the approach of Vygotsky and describe learning as a situated process in the context of social engagement with “communities of practice”. Effective collaboration with peers is a powerful learning method especially when students are encouraged to question and justify their reasoning (Soller, 2001). Once again MoonWorld seems to be designed with this strength. Team spirit during preparation, while engaged in the game, and afterwards for the post-experience is a vital element, and is intended to encourage class interaction in the age group that is targeted.

Level of Immersion

Perhaps the greatest strength of MoonWorld is its intense level of immersion and realism for the player (see Murray, 1998, Chapter 4). Even videos of missions (Avatrian, 2010) have been commented upon by fellow course members as extremely immersive giving a feeling of “being there” when driving the moon buggy.

Two examples of the high levels of immersion from our team experience are:

1. Oxygen monitoring and team discussion on the matter was to the fore, one member observing that they found themselves being more aware of their breathing.

2. When discussing the colour, morphology and crystal properties of rocks, the explorers were deeply engaged and communicating together to make entries in the mission logs, even when the team leader was trying to get their attention to move further into the route.

MoonWorld has many features of well designed and engaging videogames (Newman, 2004, p. 16).

Application of Learning Principles

We can look at MoonWorld from the perspective of Gee's (2007) 36 Learning Principles, many of which do seem to be highly applicable to MoonWorld as an educational game-like experience. As an initial exercise to better understand the principles, and to consider how to apply each of them to a specific game or simulation, I created a Gee questionnaire in Google Forms to collect the experience of the mission.

In general the group involved felt that many of the Gee principles applied very directly and they rated MoonWorld very highly for many of them. Some seemed less relevant since the simulation is intended to support learners acting as themselves even if in a fantasy (for all but a few Apollo astronauts) environment.

Subject Focus and Educational Objectives

MoonWorld has been designed with support from NASA’s educational initiatives to provide a serious educational tool to encourage interest in Science, Technology, Engineering and Maths (STEM) subjects. Specifically here it focuses on geology and landforms in an exciting and stimulating environment for the learner who may be in the middle teen and upwards age group. It goes into some depth on rock types, techniques for pick up sample and drilled core analysis and correlation. It uses a varied actual region of the Moon with interesting landform evolution. It does this in a way that is of general applicability to the focus subject and beyond.

Assessment via a quiz is included at the end of the mission, along with targets which the learner can strive to achieve. Badges are given for various levels of performance, which can encourage further attempts to reinforce the learning and see finer details of the wealth of materials included. Community consideration is augmented via elements of lab resources resupply.

Technical and Design Issues

Experience Length

The Moon mission was quite long, and a lot had to be accomplished in the 2 hours allowed. I felt that the experience could be better if the mission was split into several parts over a longer period, with the materials collected in the expedition being maintained until each phase was complete.

Technical Simulation Problems

There were some in-world simulation issues in our experience, with minor glitches in the functioning of the heavily scripted in-world EVA suits and objects. The lab analysis link up to external analysis simulations was not functioning, which meant the final quiz also could not be taken by the team. These issues are being addressed by the developers.

Conclusion

MoonWorld is a fine example of a “serious game” with an educational purpose which supports a wide range of learning principles, with features relevant to scenario-based training. It engages the learner in a deeply immersive experience which seeks to provide a wide variety of motivational elements involving challenge, fantasy and curiosity.

Word Count

Core text including subsection titles: 1,200

Acknowledgements

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References

Avatrian (2010) “Exploring Timocharis – The MoonWorld Experience”. YouTube Video, 15-Sep-2010. http://www.youtube.com/watch?v=7Q9LmhZYwwU

Brand, S. (1972) “Spacewar - Fanatic Life and Symbolic Death Among the Computer Bums”, Rolling Stone Magazine, 7th December 1972. http://www.wheels.org/spacewar/stone/rolling_stone.html

Gee, J.P. (2007) “What Video Games Have to teach us about Learning and Literacy”, revised edition, Palgrave Macmillan. Original edition 2003.

Greenfield, P. (1984) “Mind and Media: The Effects of Television, Computers and Video Games”, Chapter 7, "Video Games", pp. 86-114, Fontana Paperbacks.

Lave, J. and Wenger, E. (1991) “Situated Learning: Legitimate Peripheral Participation”, Cambridge University Press.

Malone, T. (1981) “Towards a Theory of Intrinsically Motivating Instruction”, Cognitive Science, Vol. 4 pp. 333-369. http://www.coulthard.com/library/Files/malone_1981_towardtheoryintrinsicallymotivatinginstruction.pdf

Murray, J.H. (1998) “Hamlet on the Holodeck”, Chapter 4 on “Immersion”, pp.97-125, MIT Press.

Newman, J. (2004) “Videogames”, Routledge Introductions to Media and Communications, Routledge.

Norman, D. A., (2002) “The Design of Everyday Things” New York: Basic Books. Previously published as “The Psychology of Everyday Things”, 1988.

Reese, D. D. (2008) “GaME Design for Intuitive Concept Knowledge”, in R. E. Ferdig (ed.), Handbook of Research on Effective Electronic Gaming in Education (Vol. 3, Chapter 2.10, pp. 1104-1126). Hershey, PA: Idea Group.

Rogoff, B. (1998) “Cognition as a Collaborative Process”, in D. Kuhn & R.S. Siegler (Eds.), Cognition, perception and language [Vol. 2, Handbook of Child Psychology (5th ed.), W. Damon (Ed.)] pp. 679-744, New York: Wiley.

Ruberg, L., Wood, C.A., Reese, D.D., Lightfritz C. and Harrison A. (2009) “MoonWorld: Virtual Fieldwork in Second Life”, in Proceedings of the 40th Lunar & Planetary Science Conference, March 26, 2009. http://www.lpi.usra.edu/meetings/lpsc2009/pdf/2229.pdf

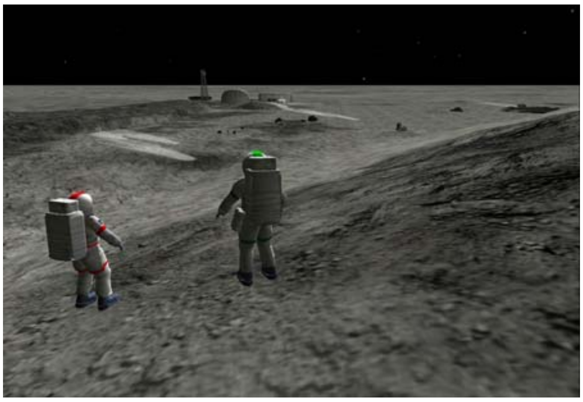
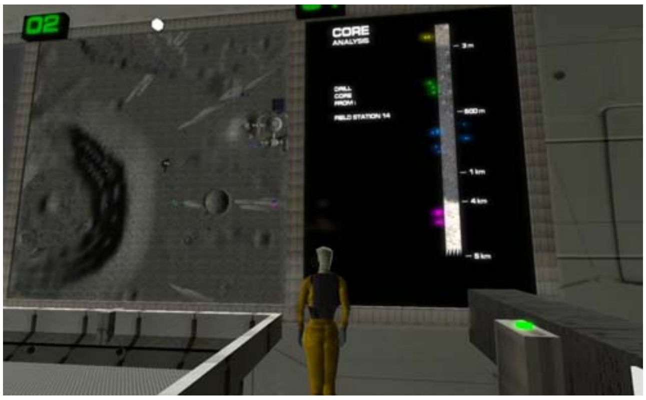
Ruberg, L., Wood, C.A., Reese, D.D., Lightfritz C. and Harrison A. (2009) “MoonWorld: Virtual Fieldwork in Second Life”, Poster presented at 40th Lunar & Planetary Science Conference, March 26, 2009. http://lpod.wikispaces.com/file/view/SL_poster2_hq.pdf

Soller, A.L. (2001) “Supporting Social Interaction in an Intelligent Learning System”, International Journal of Artificial Intelligence in Education (IJAIED), Vol. 12, pp. 40-62. http://www.cscl-research.com/Dr/documents/ijaied/2001/Soller-IJAIED.html

Vygotsky, L. (1934) “Thought and Language” (aka “Thinking and Speaking”), MIT Press (published in English in 1962). Internet version and translation by Eugenia Hanfmann and Gertrude Vakar. http://www.marxists.org/archive/vygotsky/works/words/

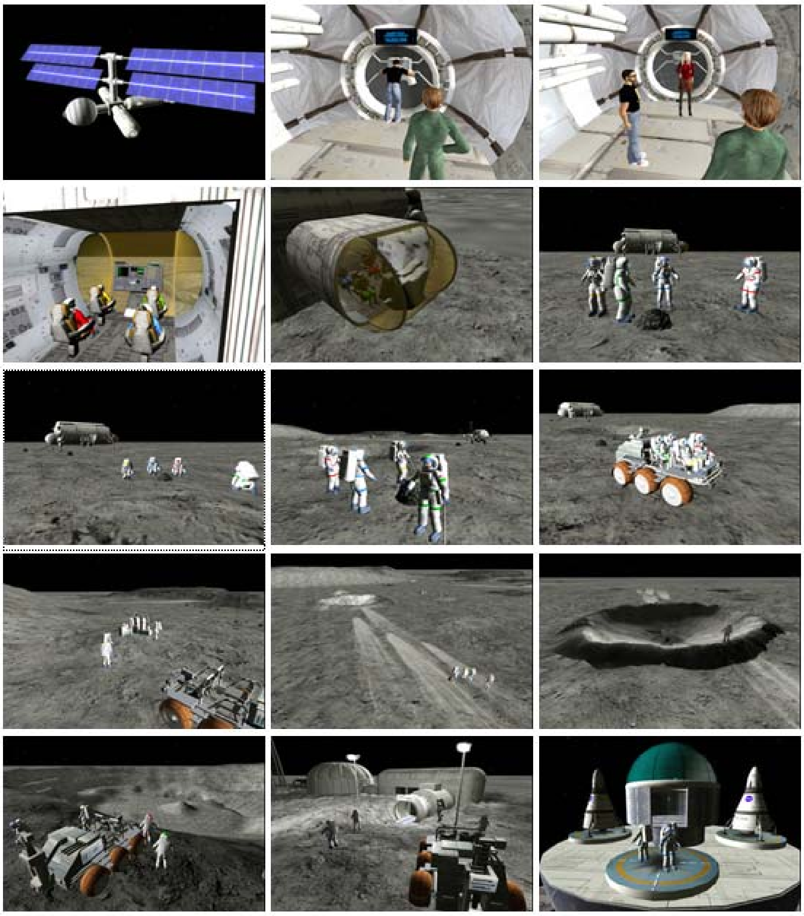
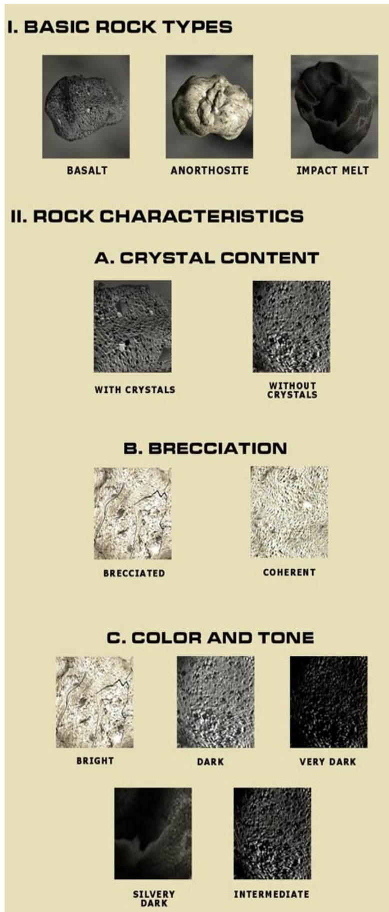
Wood, D., Bruner, J. S. and Ross, G. (1976) “The Role of Tutoring in Problem Solving”, Journal of Child Psychology and Psychiatry, 17: 89–100. http://onlinelibrary.wiley.com/doi/10.1111/j.1469-7610.1976.tb00381.x/pdf

Addendum – Team Pythagoras – Mission to Timocharis Crater – 24th January 2012

Debbie Denise Reese of CET leading on a mission to train the author

Team Pythagoras – Photo Journal

MoonWorld – Team Pythagoras – see http://holyroodpark.net/atate/weblog/7210.html

Team Pythagoras – MoonWorld Rank Badges and Scoring Factors

- Ai Austin 25.44% (Lunar Level)
- karonmcb Resident 23.67% (Lunar Level)
- indrimagri Resident 22.67% (Lunar Level)
- Kimberley Pascal 21.89% (Lunar Level)

- Averaged Team Score = 23.82%

The scores above were calculated using the following formula:

Total Score = ((FC/FT) * FW) + ((RC/RT) * RW) + ((BC/BT) * BW) + ((AP/AT) * AW) + ((CO/CT) * CW)

Field Mission Part 1 and 2

- FC = number of correct field station questions answered
- FT = total number of field station questions
- FW = weight of the score for the Field Mission section

Research Facility Analysis Part 3

- RC = number of correct Research facility questions answered
- RT = total number of Research Facility questions
- RW = weight of the score for the Research Facility Analysis section

BLISS Challenge Part 4

- BC = number of correct BLISS Challenge questions answered
- BT = total number of BLISS Challenge questions
- BW = weight of the score for the BLISS Challenge section

Activities Credit

- AP = number of activities participated in by explorer
- AT = total number of activities possible in MoonWorld
- AW = weight of the score for explorer's participation in activities

Collection Credit

- CO = number of objects (moonrocks and drill core) collected by explorer
- CT = total number of collectable objects in MoonWorld
- CW = weight of the score for explorer's collected items

Achievement Level Determination

- Total Score > 80% Cosmos Level
- Total Score > 50% AND <= 80% Galaxy Level
- Total Score > 30% AND <= 50% Planetary Level
- Total Score <= 30% Lunar Level