

NECC 2007 Workshop

3D Online Learning Environments: The Technology, Research, and Classroom Applications

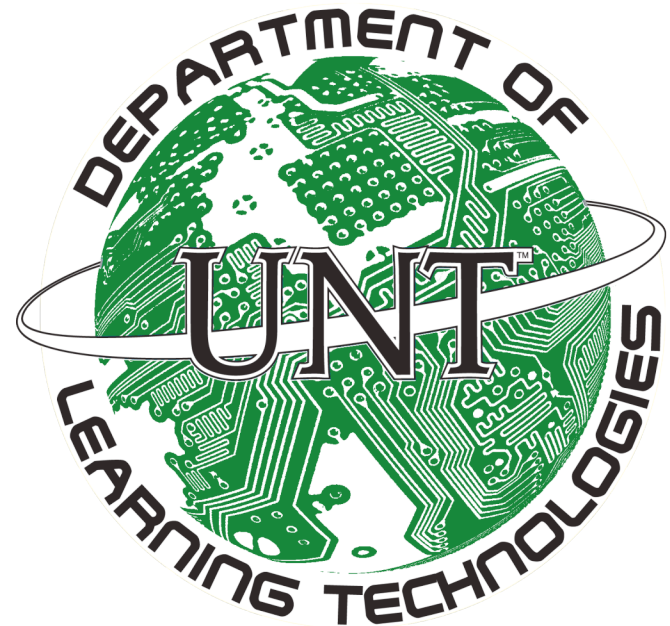
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Workshop Goals



- Explore and understand 3D online learning environments
- Examine current research on 3D online learning environments
- Discuss learning affordances of these systems
- Examine the underlying technology

Morning Schedule

- 8:30am Welcome / Intro
- 9:30am Presentation
Intro on Learning Affordances
- 9:45am Handson
3D Online Learning Environment UNT
- 10:30am Presentation
CRG Learning Affordances (CRG)
- 10:45am Handson
Second Life
- 11:45am Presentation
Second Life Learning Affordances

Afternoon Schedule

- 12noon Lunch
- 1:00pm Presentation
The Technology
- 1:30pm Presentation
Research
- 2:30pm Presentation
Motivation, Game Play, Engagement, etc
- 2:45pm Handson
ChalkHouse
- 3:15pm Conclusion

Preliminaries



- NING
 - <http://necc2007forum.ning.com/>
- Second Life Accounts
 - <http://secondlife.com>
- Participant Introductions

What is a 3D OLE ?

- Integrates
 - 3D Multi-User Environment
 - with:
 - Collaborative Groupware
 - Overheads, Whiteboard, etc
 - Unified Communications Tools
 - Chat, Messages, Audio, etc
 - while providing:
 - Informal or formal learning outcomes

Elements of a 3D OLE

- Space, Relationships, Presence
- Engagement, Interaction
- Immediacy, Feedback
- Multi-Modal
- Multi-Media
- Distributed Learning
- Bandwidth Efficient, Scaleable
 - distributed computing, digital divide

History



- Text
 - MUD - Multi-User Dungeon (1978), Text-Based
 - MOO - MUD Object Orientated (1990), Text-Based
- Graphical MMORPG
 - Massively Multi-Player Role Playing Game
 - Ultima Online (1997)
 - First 3D MMORPG - EverQuest (1999)
- Digital Worlds
 - MMO Social Game
 - 2D - Habitat (1986) then Vzones (1994)
 - 2D/3D - Active Worlds (1997)
 - 3D - There.com and Second Life (2003)
 - Educational / 3D Online Learning Environments
 - River City, Harvard, NSF (2001)
 - Quest Atlantis, Univ of Indiana, NSF (2001)
 - Created Realities Group (2002)

Affordances of Digital Worlds

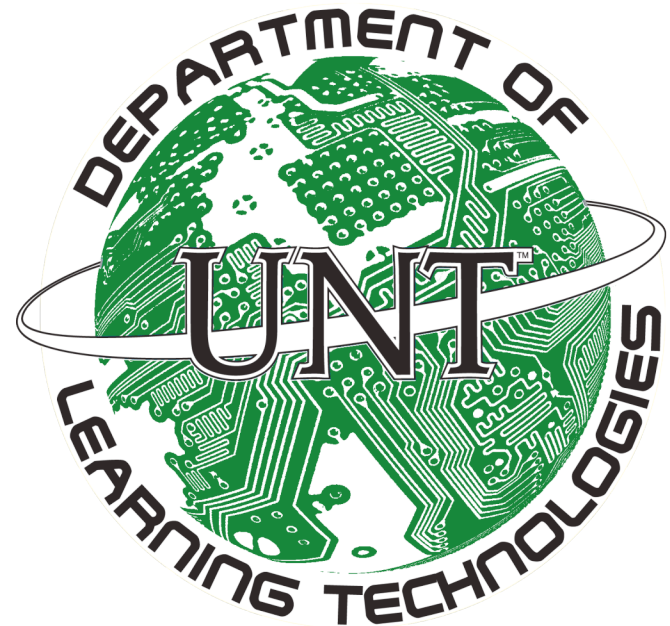
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Current uses of Digital Worlds

- Simulate real-world problems for “close” transfer (Barab, S. A., Warren, S. J., Zuiker, S., Hickey, D., Ingram-Goble, A., & Dodge, T., 2006)
- Blends face-to-face and online experience
- Situate activity within narratives as cognitive scaffolds (Barab, S. A., Zuiker, S., Warren, S. J., Hickey, D., Ingram-Goble, A., Herring, S., et al. (2007)
- Scaffold through pedagogical agents (Warren, 2006, Baylor, 2005)
- Communication
- Learning task gate keeping (Warren, 2006)



Media Affordances

What are Media Affordances?

- Perceptual properties of the environment that become apparent when perception is approached from an ecological perspective (Gibson, 1978)
- Play on involuntary instinctual responses
- Act as delivery mechanisms using senses and/or cognitive principles

Visual

- Still image
- Textual
- Digital motion video
- User or designer generated



Audio



- Recordings
 - Direct instruction
 - Audio books/narrative delivery
 - Narrative



Interactive

- Use of tools
 - Keyboard input
 - Mouse input
 - Other input (e.g. gloves, heart rate, etc.)
- Use of simulation
 - Environmental model changes as directed and experienced by learner
 - Examines causes and consequences in a safe environment



Communicative

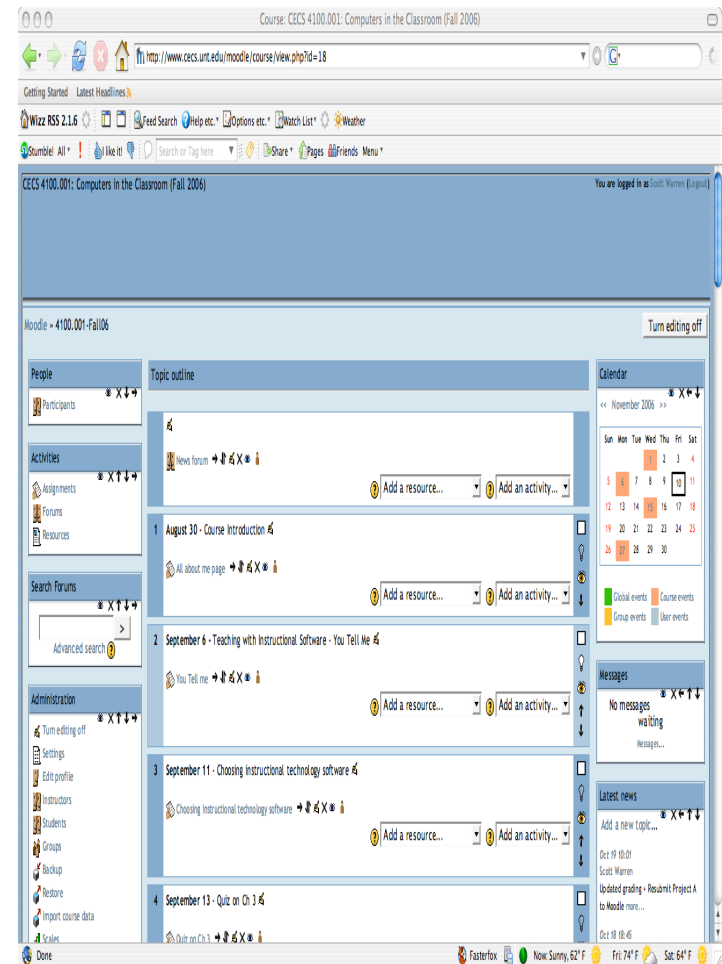
- Permits user to communicate with peers OR systems in a least one way
 - Asynchronous chat
 - Email (internal or external system)
 - QA's Telegram system
 - Synchronous chat (e.g. AOL IM)
 - Audio (e.g. VoiP [Skype])
 - Video (e.g. iChat)
- Habermas' (2001)
Theory of Communicative Action



Learning Affordances

What are Learning Affordances?

- Borrowed from Media Affordances
 - Visual/Spatial
 - Auditory
 - Interactivity/Feedback
 - Communicative
 - Cognitive scaffolds
 - Motivational
 - Identity



Visual/Spatial



- Text (Hartley, 1996)
- 2D images (Braden , 1996)
- 3D images
- Movement within structure
 - Cognitive organization - “I know where”
- Stimulus and response - associative
- Organization of information



Auditory



- Dual coding theory (Paivio, 1986)
 - Audio + visual = more effective
- Means of content delivery for auditory learners to supplement video
- ESL learners benefit from audio > video (Englert et al, 1999)

Interactivity + Feedback



- Interaction with learning objects
 - Static
 - Textual
 - Quests/Learning Tasks
 - Pedagogical agents (Baylor, 2005)
- Environment
 - Dynamic changes to narrative
- Peer
- Instructor

Communicative



- Collaboration (Thomas, 2003)
- Competition
- Coordination
- Cooperation

Cognitive scaffolds



- Hard scaffolds
 - Pedagogical agents (Baylor, 2005)
 - Textual (e.g. hypertext, directions)
 - Developmental tasks (difficulty changes, varies)
 - Direct Instruction (DI)
- Soft scaffolds (Brush & Saye, 2001)
 - Peers
 - Instructor

Motivational



- **Quest Atlantis** (Tuzun, 2004, Skaalvik, 1999)
 - Limited game structures (Barab, et al, 2007)
 - Advancement/Leveling (Barab and Roth, 2007)
 - Economy (Castranova, 2001)
- **Anytown** (Warren, 2006, 2007)
 - Narrative
 - Free choice writing activities
 - Feedback

Identity



- Role play (Murphy, 1997, Steinkuehler, 2005)
 - Splintered identities/Experimentation
 - I am me, but a different me
 - I am Jacob Metropolitan
 - I am a reporter
 - I am Klahtrakt
- Safety/Cloak of Anonymity
- Authenticity of role
- Internalization of experience

I am me, but different



- Where it is found:
 - Quest Atlantis role play (Barab, et al, 2007)
 - Avatar as me with a similar identity
 - Identity develops through activity in 3D
 - Identity is tied to advancing within narrative
 - Identity building is tied to helping others



I am a reporter



- Where we find it:
 - Anytown, Chalk House, River City
 - I am me, but in a different job
 - I am Scott Warren, reporter for the *Telegraph*
 - I do those authentic tasks that a reporter does
 - I receive feedback on my work and my work becomes part of me



Muradin

Change Realm

Detroit
Level 13 Warlock
Redridge Mountains

Kandinsky
Level 46 Druid
Ashenvale

Pressman
Level 14 Rogue
Ironforge

Dekoening
Level 18 Mage
Elwynn Forest

Thistlenacht
Level 2 Priest
Teldrassil

Frustration
Level 6 Paladin
Eversong Woods

Ennuidei
Level 10 Shaman
Azuremyst Isle

Klahtrakt
Level 61 Hunter
Eastern Plaguelands

Izobelle
Level 13 Priest
Bloodmyst Isle

Create New Character

Klahtrakt

Enter World

AddOns

Delete Character

Back



I am Klahtrakt

- Where we find it:
 - Video games, Second Life
 - I am me, not me at all
 - I am a hunter
 - I am a Tauren
 - I am level 61
 - I am part of the Horde
 - My allegiance is to Thrall
 - I am a destroyer of men





Kandinsky

Muradin

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Conclusion

- Media affordances vs. learning affordances
- Simulation
- Experimentation
- Play
- Today's Examples
 - CRG
 - Second Life

CRG 3D OLE Hands On & Learning Affordances

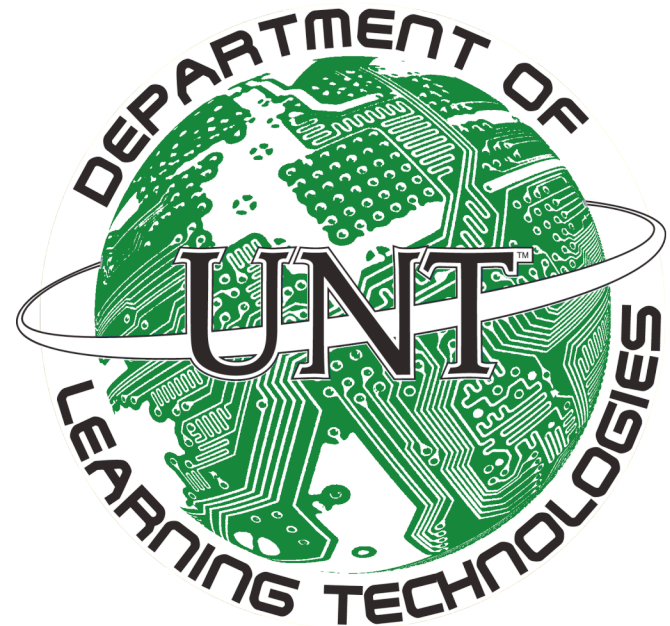
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UNT Course Environment Demo



- Launch Configuration to set screen resolution
- Login: first initial last name
- Password: necc

- Move: ASDW keys
- Chat: Press Enter, Type, Press Enter
- Audio: Press and Hold \ to talk

- Environment scaled down to study simpler setting

3D Online Learning Environment

- Used since 2002 for selected UNT courses
- Instructional Course Delivery and Support
- Typically used in a blended mode
- Research questions
 - Student satisfaction
 - Learning Outcomes
 - Discourse
 - etc



The Goal



- To create a ‘learning community’ from students that are both bandwidth and time limited and that have never meet that can then self-create and self-sustain meaningful text-based asynchronous communications over the course of the semester.
- When this is achieved this has the highest benefit to the student’s learning and the lowest impact on the instructor’s limited time and energy.

Some Definitions



- **Meaningful Communications / Content**
 - Messages that contain content that is relevant to the course curriculum.
 - Hellos, Vacations, Football etc are not content (Note: a healthy community should have these!)
- **Self-Creating Communications**
 - Students post original messages that are not required by the course.
- **Self-Sustained Communications**
 - Students answer and respond to each others postings without instructor intervention.

The Problem



- A very short time available to achieve the formation of the learning community
 - Long Semesters - +/-15 weeks
 - Summer - 5 weeks - 10 weeks
- Limited contiguity of communications
- Pressures built-in to the system that limits available participation
 - Mid-term, Finals, End of Semester
 - Family, Work, etc

Some of the Research...

- To create a self-sustained learning community (see goal):
 - With content focused on a curricular topic, with facilitator to ensure no break in communications, and with fairly consistent text-based communications (2-3 messages a week) it takes between 10 and 14 weeks (Jones & Harris 1999; Jones 2001).
 - Add active instructor (10+ hours a week) that drops down to 8 and 12 weeks. (Jones, unpublished).
 - Add face-to-face meetings (blended) early in the semester and drops it down to less than a month (Jones, in press).

What accelerates the process

- Cohorts
 - Does not accelerate, it provides for the extended communications over more than a single semester
 - Students also tend to meet face-to-face over time
- Blended
 - Increase the fidelity/feedback mechanism with face-to-face contact hours.
- Technology Enhancements
 - Increase the fidelity/feedback mechanism with elements that provide face-to-face like contact hours.
 - Technology selection impacts cost to school and student population.

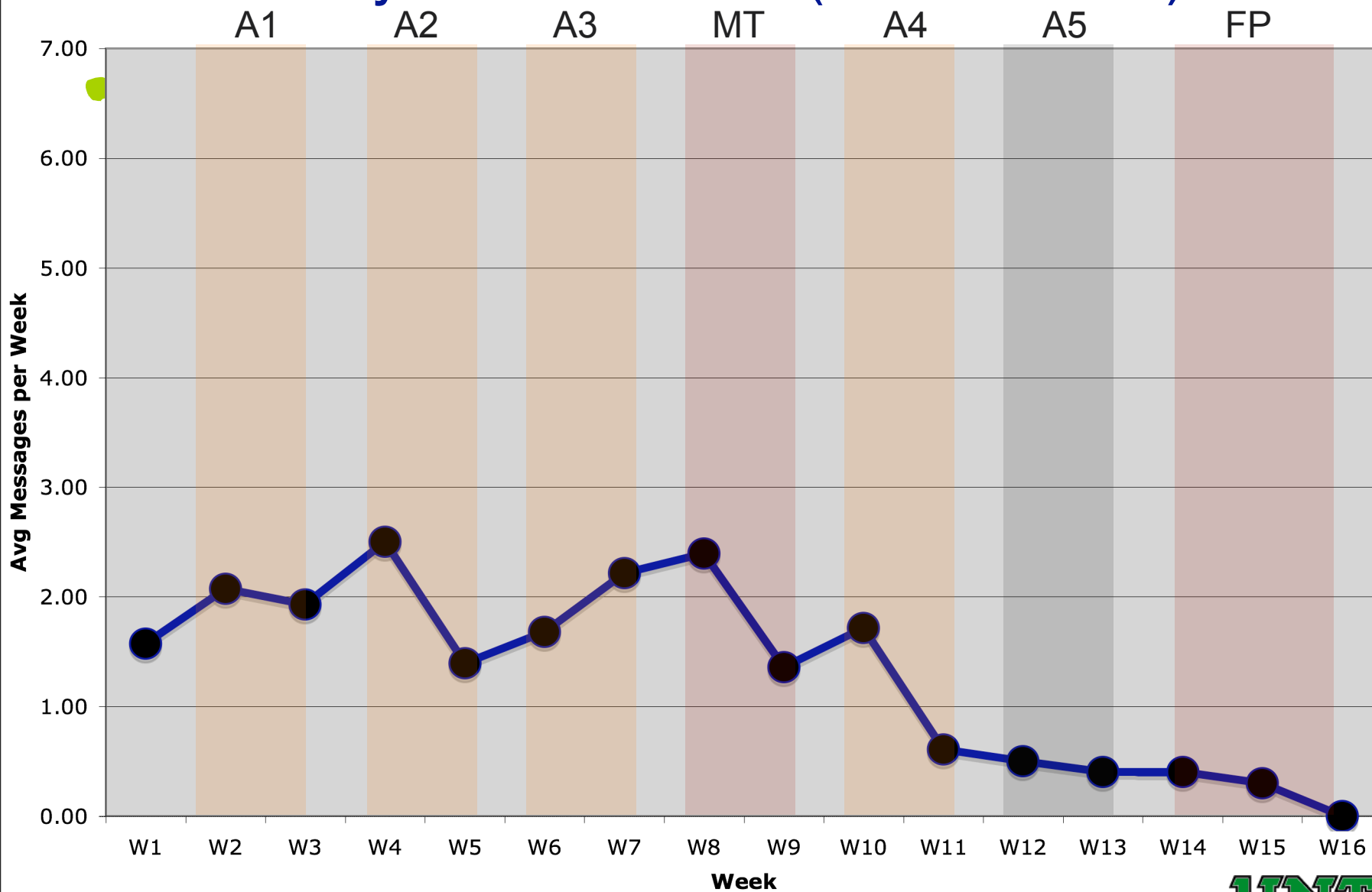
Study on Discourse and Rapport

- Comparing courses taught using the same discourse requirements and instructor interaction and similar assignments between the fall of 2004 and fall of 2005.
 - Internet Only, Web LMS (no face-to-face, no 3D OLE)
 - Internet Extended (at least 50% face-to-face and Internet Tools)
 - 3D OLE (3D OLE, and Internet Tools)
- Each type consists of three or more courses over 3 long semesters.

The main points

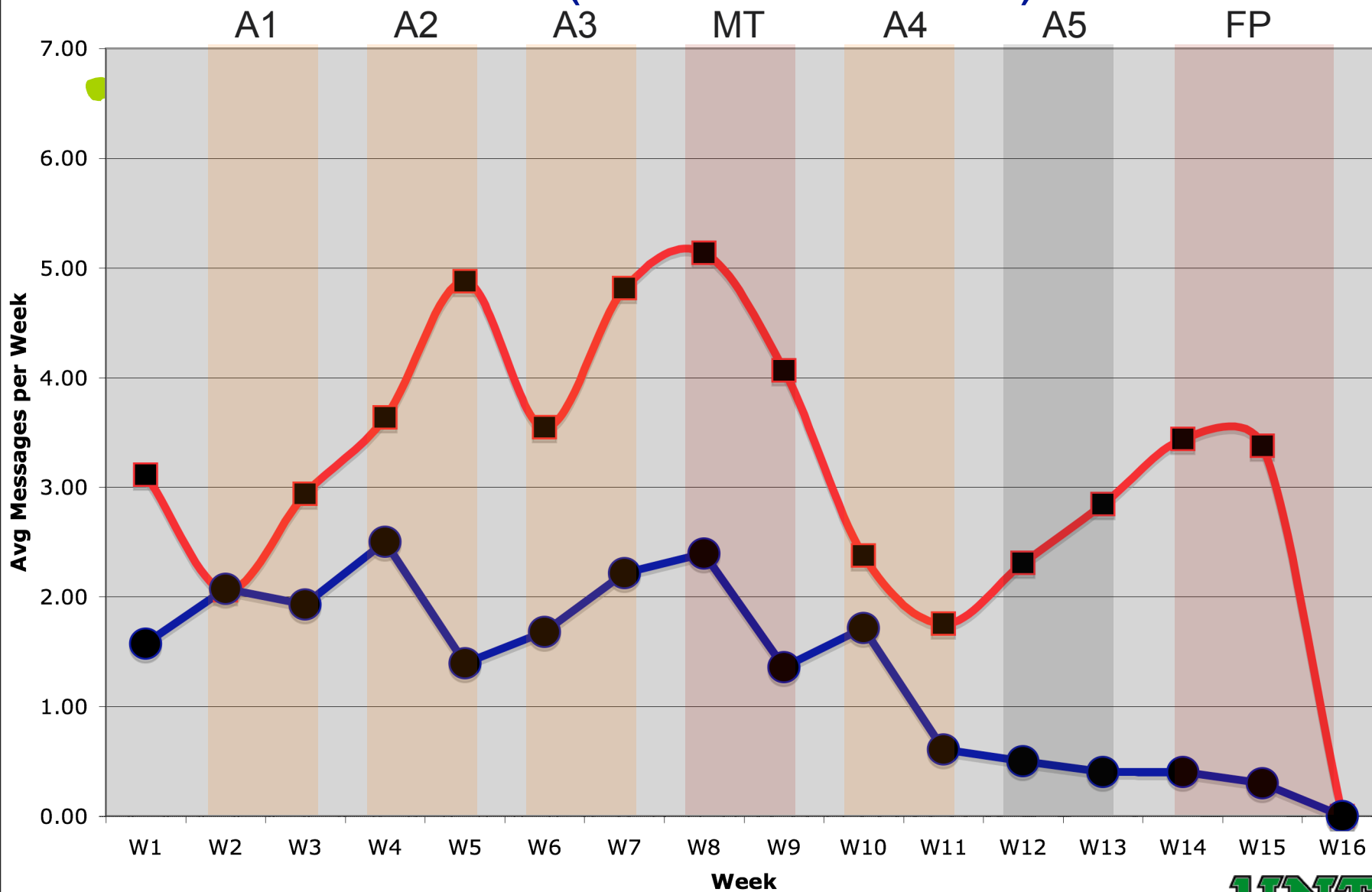
- Adding a 3D online learning environment to existing text-based communications used for course discussion at the graduate level:
 - accelerates rapport
 - greatly increases number exchanges
 - increases depth of discourse
 - sustains discourse longer over the semester
- Theory: Cognitive Scaffolding accelerates rapport building (presence)

Internet-Only LMS Course (no f2f or 3D)



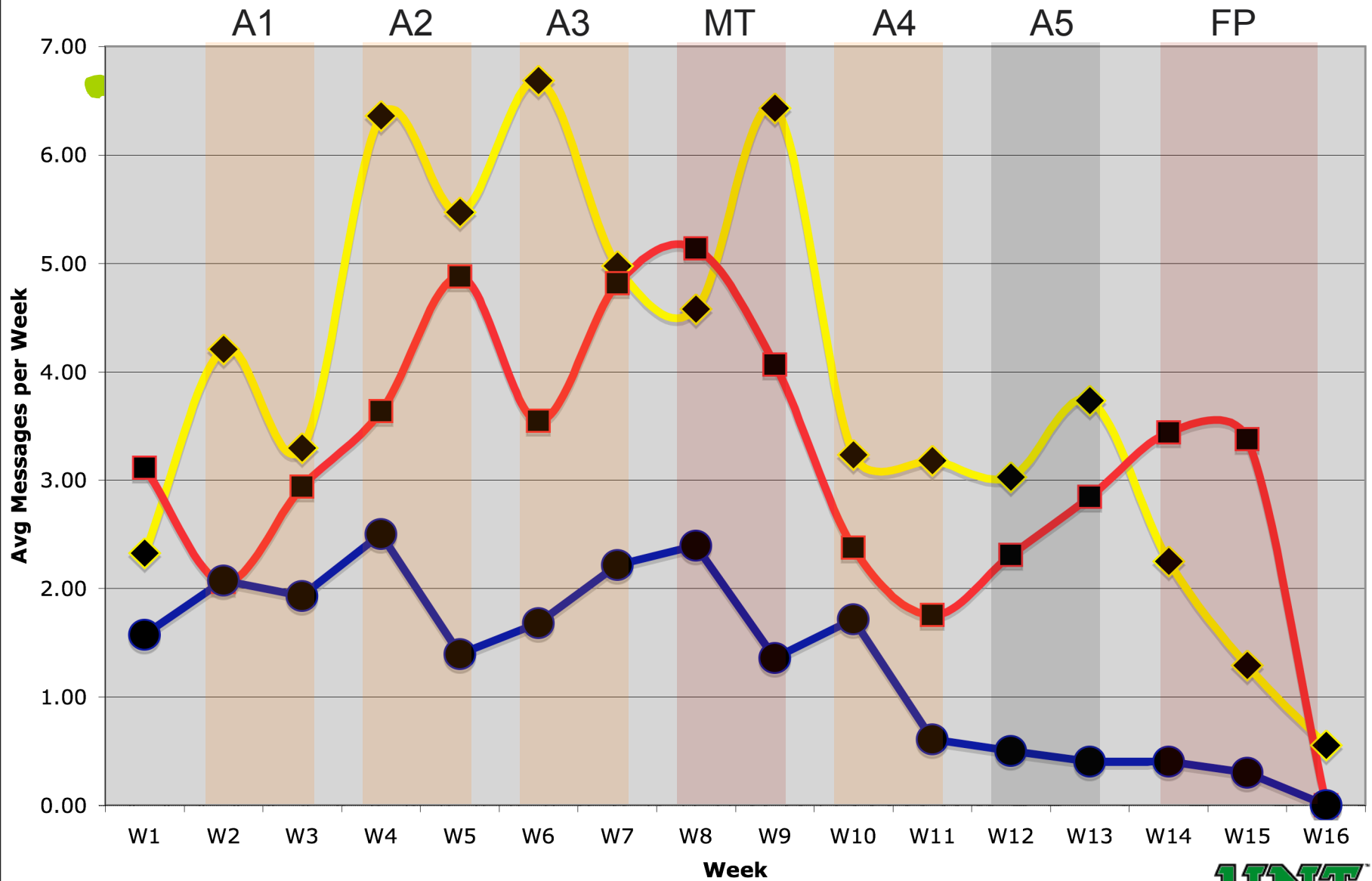
◆ ■ ● Courses Web-based and E-mail

Internet Extended (multi f2f + LMS)



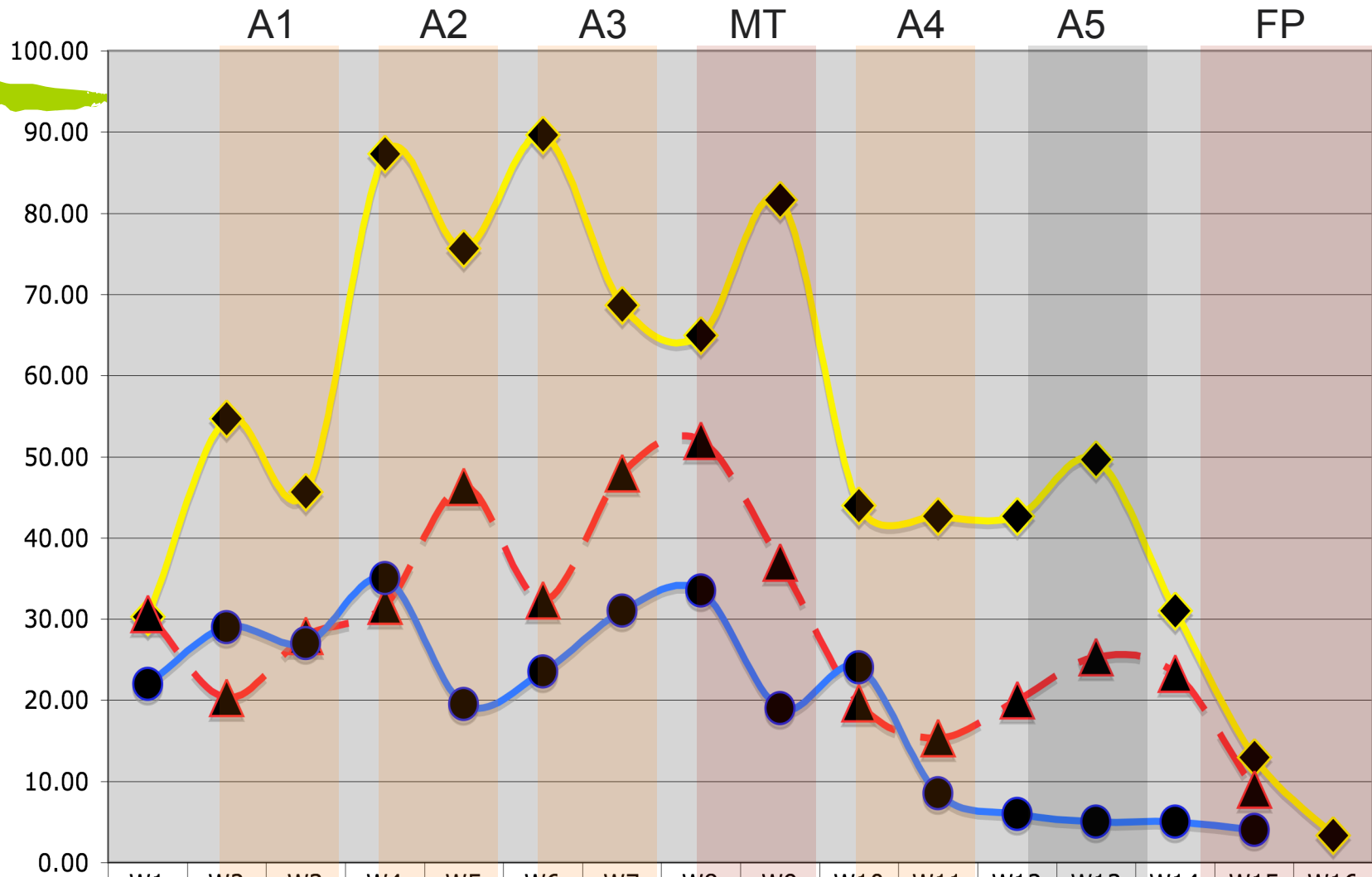
◆ Courses Face-to-Face and E-mail ● Courses Web-based and E-mail

3D OLE (3D OLE + LMS)



◆ Courses using 3D and E-mail
 ■ Courses Face-to-Face and E-mail
 ● Courses Web-based and E-mail

Avg Message Totals by Delivery Type



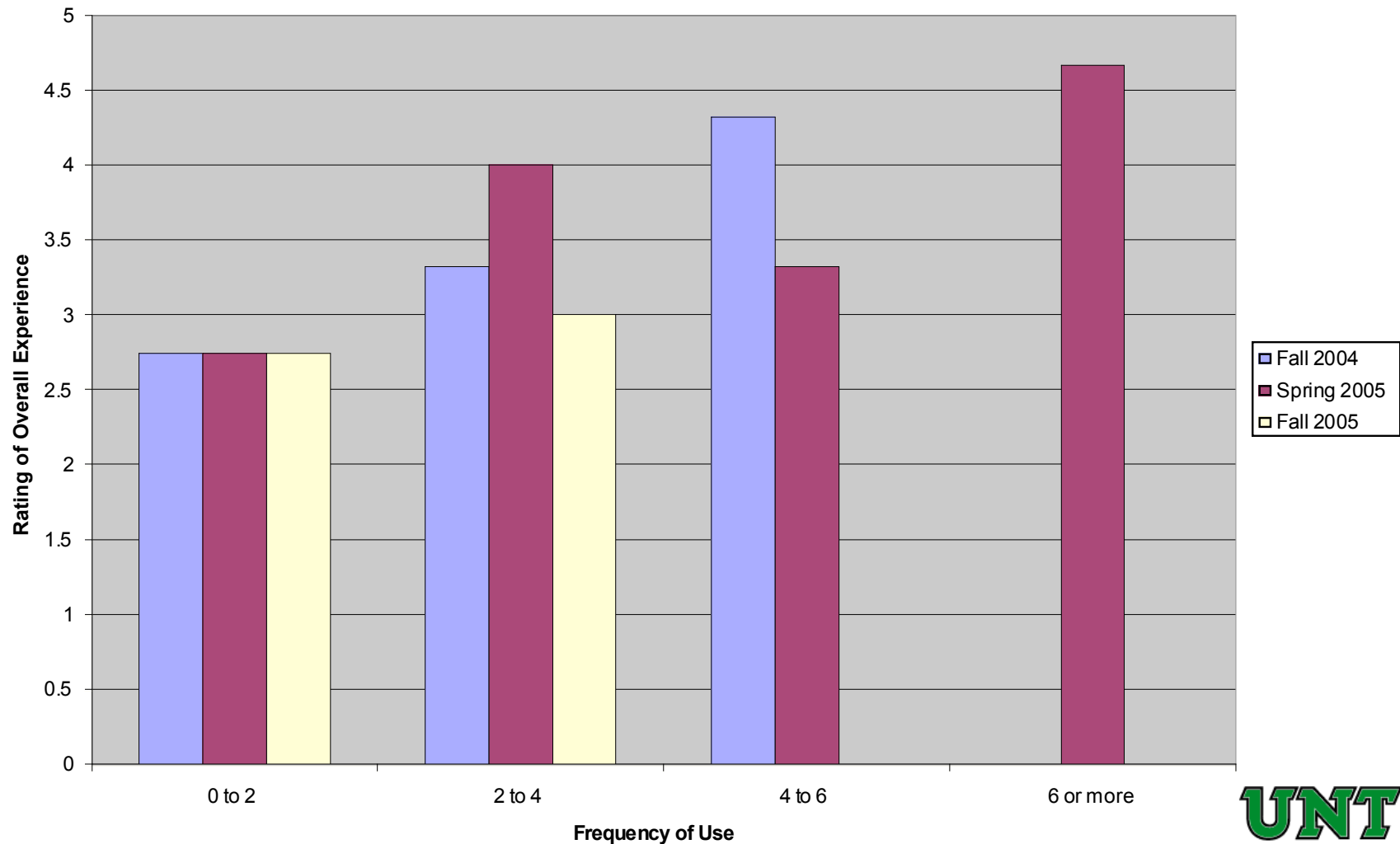
	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15	W16
CRG/List	30.33	54.67	45.67	87.33	75.67	89.67	68.67	65.00	81.67	44.00	42.67	42.67	49.67	31.00	13.00	3.33
F2F/List	30.67	20.33	28.00	31.67	46.33	32.33	48.00	52.00	37.00	19.67	15.33	20.00	25.33	23.33	9.00	
WebCT	22.00	29.00	27.00	35.00	19.50	23.50	31.00	33.50	19.00	24.00	8.50	6.00	5.00	5.00	4.00	

Initial Discourse Analysis

- Internet Only (LMS)
 - The **majority of postings were only fulfilling the required discourse** parts of the assignments.
 - Students were more likely not to complete discourse assignments at the end of the semester.
 - The majority of postings not related to assignments are “Information Requests” from students to the Instructor.
- Face to Face + LMS
 - The **majority of postings were follow-up discussions** that went beyond the minimum requirements of the assignment.
 - The majority of messages not related to assignments, were messages between students - helping each other.
- 3D OLE + LMS
 - The **majority of messages were students helping each other.**
 - Followed by students discussing course topics beyond the minimum requirements of the assignment.
 - Students were answering questions faster than the Instructor, who was answering postings within 4-8 hours.

Frequency of use impacts satisfaction

Figure 3: Frequency of Use Relative to Rating of Overall Experience



Cognitive Scaffolding

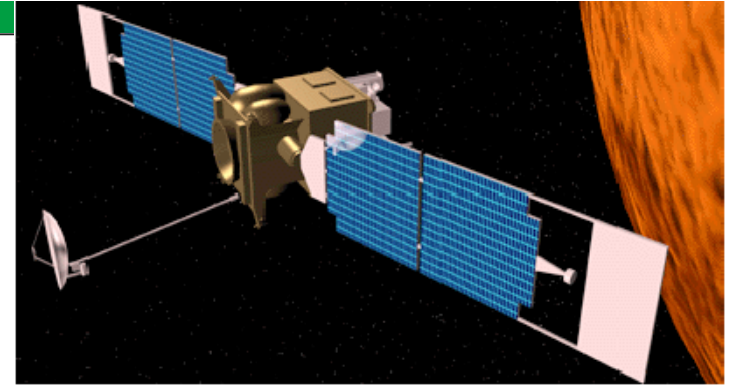


- Text-based communications alone requires extended contact between participants to build trust and connection - then significant discourse happens.
- The 3D environment like video conference or meeting face-to-face increases what I am defining as cognitive discourse scaffolding.
- Cognitive Discourse Scaffolding
 - Mechanism to more quickly build discourse communities (Rapport)
 - Building trust
 - Creating Mental Images/Maps

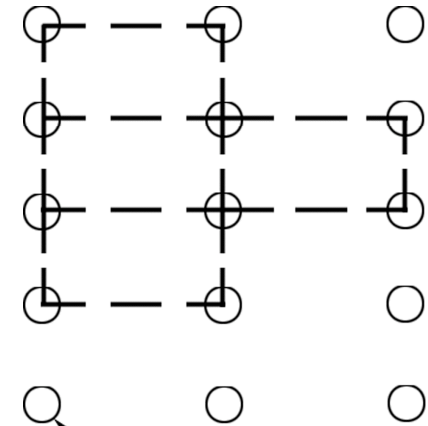
So...what does this mean ?

- This means if we increase the perceived fidelity/feedback of communications, we can then accelerate rapport building that then creates the learning community we are seeking.
- 3D online learning environments provides the required fidelity/feedback without increasing the student's current computing or bandwidth limitations.

Mars Online



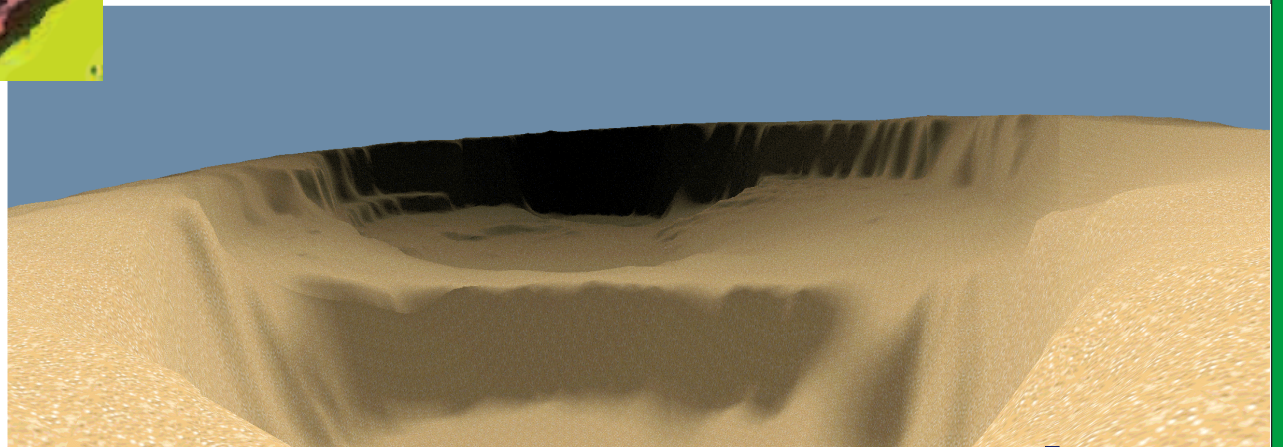
- NASA's Mars Global Surveyor, Mars Orbiter Laser Altimeter (MOLA)
- MOLA dataset represents some 600 million entries giving longitude, latitude, and elevation in 0.463km increments in long sequential lines (sweeps)
- Each portal is created from 64x64 data points creating a 29.623km sqr surface by portal (6k of data)
($0.463\text{km} * 64 = 29.623\text{sqr km}$).
- A little over 2 Gigabyte database of portal and related group information.



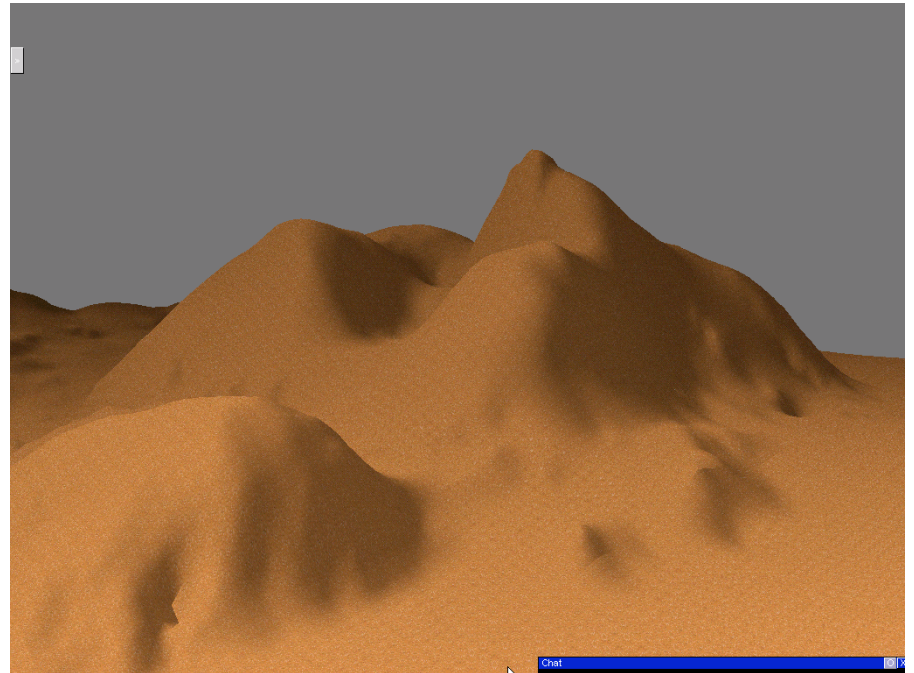
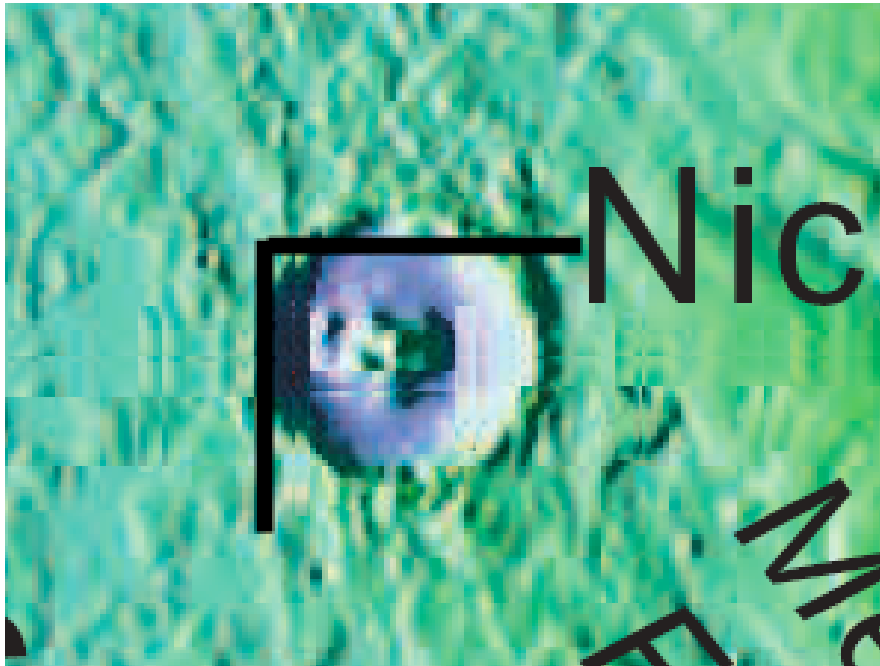
Jones, G., Kalinowski, K. & Hicks, J. (2007). Touring Mars Online, Real-time, in 3D for Math and Science Educators and Students. *Journal of Computers in Mathematics and Science Teaching*. 26 (2), pp. 123-136.

Long, Lat, Evel Data Point

Mars Online (Olympus Mons)



Mars Online (Nicholson Crater)



CRG Benefits



- Student Transparency
- Audio Chat
- Portal Based Communications
- Context
- Etc...

Evaluation / Research Affordance



- Audit Trail
 - Everything a user does can be stored
- User Logs
 - When and how long users were in the system
- Stored Audio and Text available for analysis

CRG Learning Affordances



- Visual / Spatial
- Auditory
- Interactivity / Feedback
- Communicative
- Cognitive scaffolds
- Motivational
- Identity

Affordances of Second Life

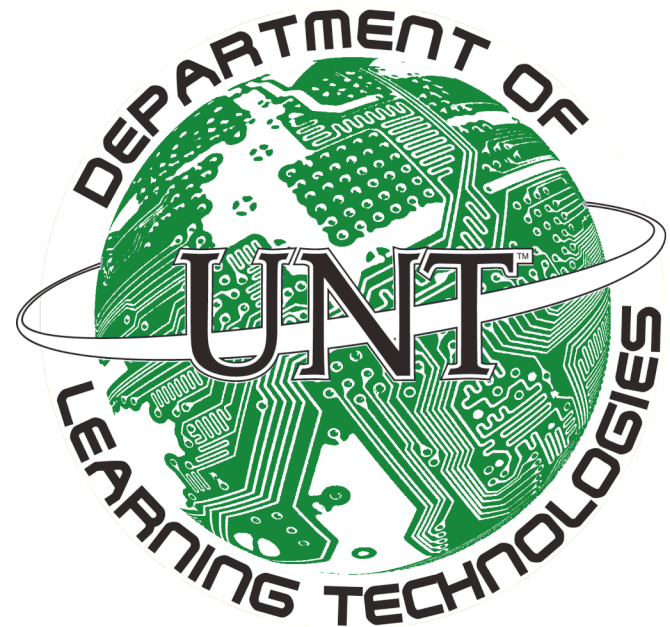
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Second Life



Second Life Learning Affordances



- Visual/Spatial
- Auditory
- Interactivity
- Communicative
- Cognitive scaffolds/Learning Objects
- Motivational - Hawthorne Effect
- Identity



Why Second Life?

- Upload Image (L\$10)... Cmd-U
- Upload Sound (L\$10)...
- Upload Animation (L\$10)...
- Bulk Upload (L\$1 per le...
- Close Window Cmd-W
- Save Texture As...
- Take Snapshot Cmd-Shift-S
- Snapshot to Disk Cmd-`
- Start/Stop Movie to Disk Cmd-Shift-A
- Set Window Size
- Quit Cmd-Q

Second Life as Meeting Space



Other tools to support SL



- Moodle is an open-source, online learning management system
- Development time is short compared to other systems like WebCT
- Allows “non-techie” instructors to post resources, allow students to turn in assignments, and develop a course rapidly and iteratively
- **FREE!**

Hands-on Activity with Second Life



- Go to <http://necc2007forum.ning.com>
- There are three activities:
 - Getting started in Second Life/Orientation

Research support for Digital Worlds

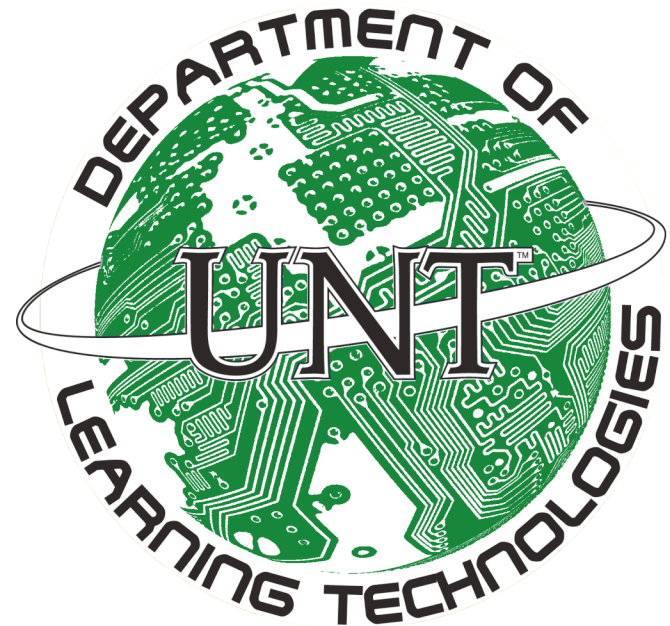
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Games and sims



- Science (Jenkins & Squire, 2003)
 - Supercharged
 - Provided students with a model of a complex system
 - Showed improvement in student understanding of science concepts
 - Alien Rescue (Samosonov et al, 2006)
 - Limited impact on science achievement, higher impact on attitude towards material

Games and sims 2



- Social studies (Squire et al, 2004, 2006)
 - Civ III
 - No objective data, but students report high interest in history after use
 - Interview data indicated that students enjoyed controlling the simulated activity
 - Not a real simulation

Games and sims 3



- LA/Reading
 - Anytown (Warren, 2006, 2007)
 - Showed impact on student writing achievement in 8 class periods
 - Reduced teacher time spent giving directions
 - Increased the amount of student

MUVES



- Science/Inquiry-based Learning
 - Quest Atlantis (Barab et al, 2006, 2007)
 - Has found impacts on student achievement on targeted items
 - Immerses students in a fictional, science fiction world combining 3D world with traditional materials
 - River City (Dede, 2006)
 - Historical simulation
 - Limited impact on achievement, high on motivation, satisfaction



Instructional design approach

Analysis



- Appropriate instructional methods for learning goals
- Identifying virtual worlds for learning
- Commensurability of learning goals and digital affordances

Design



- Technology professionals vs. education professionals
- Proprietary system intentions and limits
- Contributions of the system
- On and off-task behaviors

Development



- System intention
- Technology skill
- Cost
- Time
- Product testing

Implementation



- Student subversion of the system
- Teacher subversion of the system
- System learning curve
- Multiple learning styles
- It is not as cool as you think it is
- School policy and equipment

Evaluation



- The impact of complex worlds
- Standardized assessments
- Qualitative assessments

Concerns



- Commercial products
- User violations and system values
- Kids and virtual worlds
- Identity
- Too much time in the virtual

Application in SL



- Within SL, go to Jingyo, 165, 8, 56
- Analyze the space and determine how you would reconfigure it to teach something or make it more useful
- Make sure to focus on which learning affordances you would use and why they are appropriate to the content area/topic
- Feel free to delete, build and experiment

Big questions about Virtual Worlds



- Can they be studied effectively?
- Are they more efficient than current instruction?
- Can they be more effective than current instruction?
- Can they improve the experience of learners?

The future of Virtual Worlds in Education



- What must be done for viability?
 - Dedicated systems with education in mind
 - Successful *open* models with reasonable costs - ARGs
 - Research findings supporting use and complex designs
 - Research models with validity/reliability 04

3D Technology

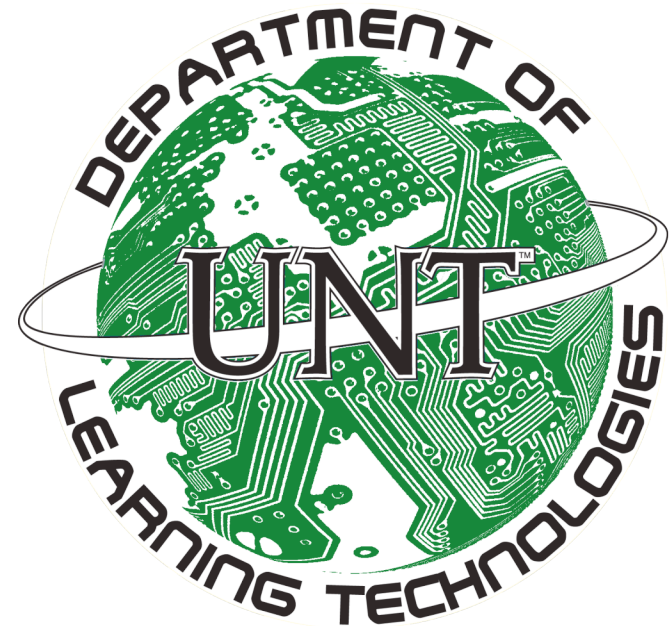
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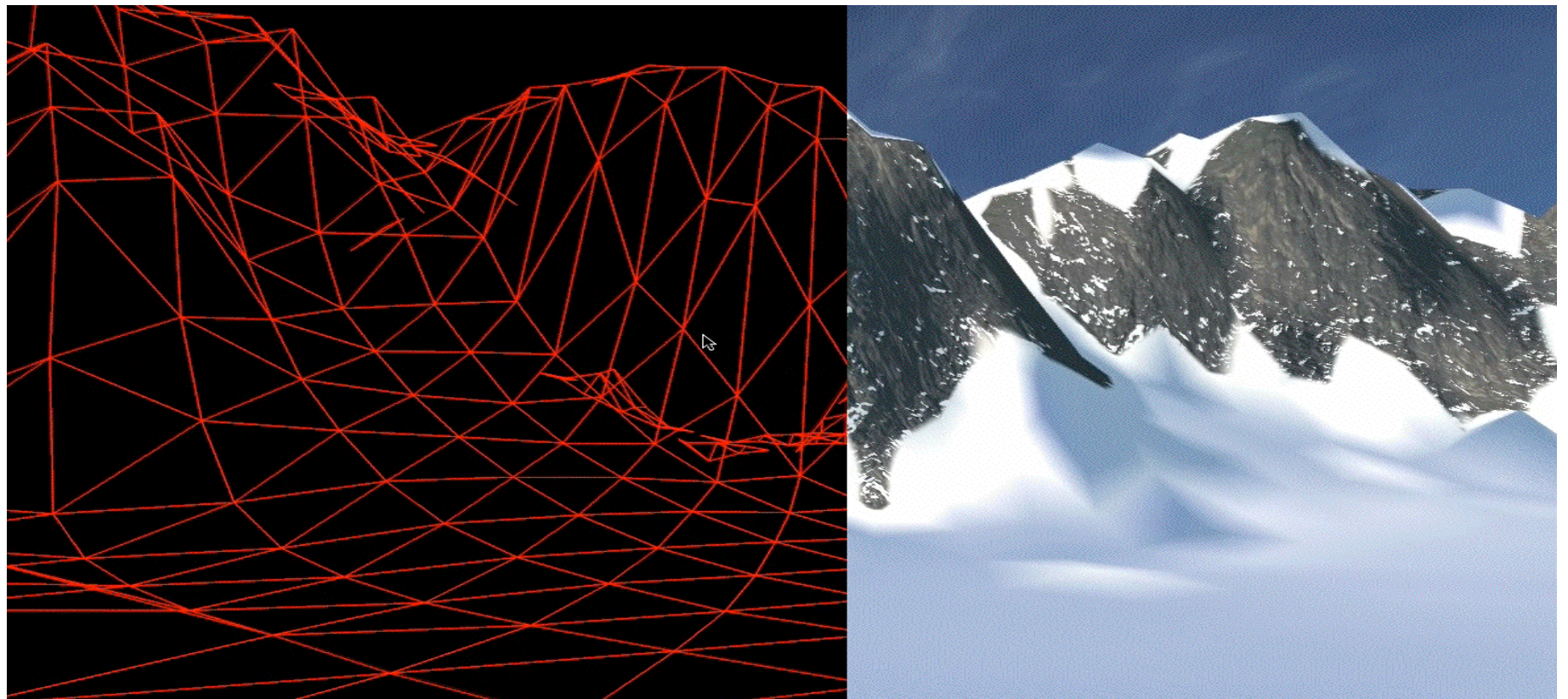
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What is 3D ?

- The display of triangles (called polygons) faced, connected, and textured in such a way that the user perceives a 3D image.
- A graphics card that supports the 3D math API.



Why is 3D more possible now?

- 1999 and 2000
 - Consumer Computer Technology Plateau
- Barriers to Access begin to decline
 - Internet common and affordable
 - Personal Computer Performance
 - 3D GPU in over 90% of shipped units
- Video devices have gone from 20,000 polygon displays in 1999 to 3D scenes derived from 200million in 2004, and even more in 2007.

1998 Graphics - Half-Life



From 1998 to 2004 Graphics



1:44 Excerpt from half-life2 demo.

Virtual People in 2004 Graphics



1:14 Excerpt from half-life2 demo.

Photorealistic 3D Environments



:53 Excerpt from half-life2 demo.

Scene and Physic Engine 2004-05



3:06 Excerpts from UnrealEngine3 & Halfife 2.

Now 2007

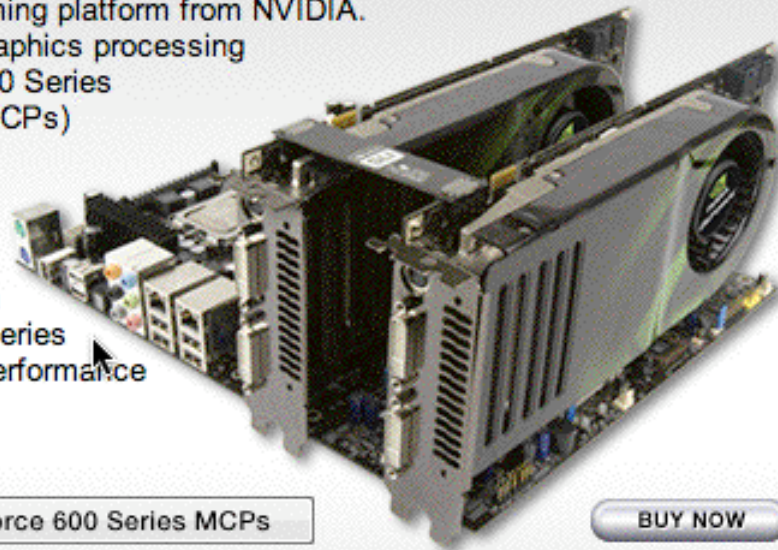
- GPU are as powerful or more powerful than the CPU.
- Some systems require multiple cards

NVIDIA® GeForce® 8800 GPUs and NVIDIA nForce® 600 Series MCPs

Redefine reality with the definitive gaming platform from NVIDIA.

The new NVIDIA® GeForce® 8800 graphics processing units (GPUs) and NVIDIA nForce® 600 Series media communications processors (MCPs)

are architected for maximum gaming performance. With up to 2X the performance of previous generations, **GeForce 8800 GPUs provide** unparalleled levels of graphics realism and image quality, while nForce 600 Series MCPs deliver incomparable system performance for both Intel and AMD processors.



GeForce 8800 GPUs

nForce 600 Series MCPs

BUY NOW

UNT

UNIVERSITY OF NORTH TEXAS

People and things in 2007+



Nvidia 2007 2:11

Movies in real-time on your computer ?



ATI 2007 Whiteout
3mins

More Polygons = Greater Detail



ATI 2007 Tessellation
46 secs

Consumer Technology Lag

Introduction

- 1999 →
 - 3D Graphics Acceleration
 - $\approx 50,000$ +/- polygons
- 2002 →
 - Pixel and Vertex Shaders
 - $\approx 500,000$ +/- polygon
- 2004 →
 - Normal Maps
 - 1+million polygons
- 2007 →
 - 10+million polygons
 - Multi GPUs

Widescale Adoption

2003-2004

2006-2007

2008+

???

Old Barriers Gone, New Barriers Emerge



- Old Barriers
 - Graphics Card
 - Internet Access
 - Computer Performance
- New Barriers
 - Content
 - Capture, Storage, Presentation
 - Investment
 - Few Standards and changing standards
 - Content Creation Expensive
 - Content Interoperability and Migration Issues

So -- where do we find ourselves?

- For wide scale deployment and adoption means using 1999-2001 technology
- Thus:
 - Low-Res environments (<75,000 polys)
 - Limited texture buffer
 - Limited data transfer between CPU and GPU
- However, this falls short on some issues:
 - Scans are creating millions of polys minimum
 - Kids and young adults are expecting current graphic expectations

Technology is only the interface

The technology provides the interface..

Technology Deployment and
Instructional Design
provide the
learning potential.

Chalk House Hands On Learning Affordances

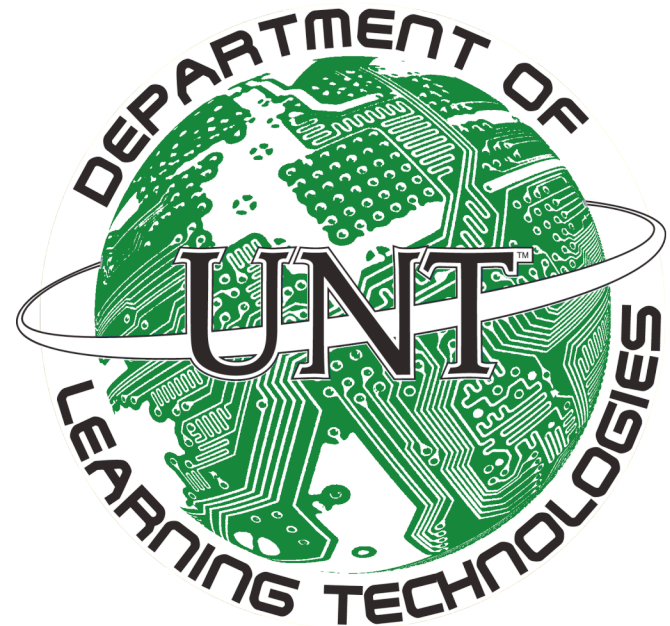
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What is Chalk House?



- Literacy module
- Targets 8th grade
- Reading and writing
- Mystery/Ghost story narrative



General Literacy

- Writing practice
- Reading focus
- Evaluation of authentic writing tasks
- Use of writing to solve problems
- Uses Texas standards as basis
- Evaluation is part of activity



Narrative



- Students begin as fledgling reporters
- Investigate the disappearance of Rebekkah and Caleb Forrester
- Ghost story unfolds as students complete writing and reading tasks
- Reading tasks are part of puzzles

Learning Affordances



- Visual/spatial
- Audio
 - Collaboration
 - English language modeling
- Interactivity/ Feedback
 - System feedback
 - Teacher feedback (role played)
- Communication
 - VoiP
 - Synchronous text

Learning Affordances continued



- Cognitive scaffolds
 - Gradual increase in complexity
 - Gradual increase in difficulty
 - Slow removal of “hard scaffolds”
- Motivational
 - Items and rewards
 - Success opens new activities
 - Game and learning blend
- Identity
 - Authenticity of role
 - Authenticity of tasks

Reception / Penny

Welcome to the
Telegraph



Newsroom



Editor in Chief

Lets start on your first story.



Conclusions

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