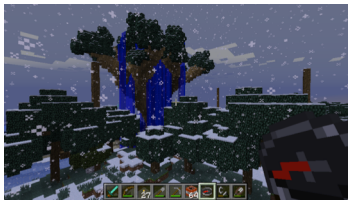

**Figure 1**. Minecraft is an open world game for creative play as demonstrated by the creations of our players. Minds of Chimera, our modified Minecraft server, allows gamers to modify and create quests for instruction and constructivist learning. We have been adding kinematics, Boolean logic and computer programming end-user tools as well as researching how to inspire creation and learning.

# Using Minecraft for Instruction and Creative Play

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## Abstract
Inline with the BSCS 5E instructional model, the Minds of Chimera project is using constructivist learning to instruct and motivate creativity in a heavily modified Minecraft game server. We currently are developing games around kinematics, Boolean logic and computer programming to inspire player creativity and create new games. We are using a model of inspiration based on Investment Theory's creativity resources.

## Author Keywords
Creativity; Inspiration; Constructivism; Minecraft

## ACM Classification Keywords
K.3.0. Computers and Education: General

## Introduction
The potential for collaborative constructivist learning using Virtual Worlds is promising, but elusive. Gamers quickly recognize it for what much of it is: shallow gaming, poor stories, bad gameplay and artistically lacking environments. Enter Minecraft (http://minecraft.net), an open world indie game paradoxically attracting the attention of typical gamers with: no plot, no story, no goal, simplistic combat and bad graphics. Selling more than 3.5 million copies before being released and winning the VGA 2011 indie

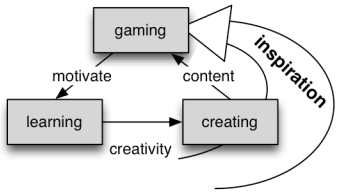


**Figure 2**. We are exploring a gaming, learning and creating cycle in constructivist learning. Players are motivated by the game to learn and through our inspiration, to employ their creativity to make new content for other players.

game of the year, this game's success derives from collaborative creativity with exploration and adventure.

In the Minds of Chimera project (see Figure 1), we are looking at how to deliver constructivist educational instruction through gaming as well as to inspire [6] creative content creation (see Figure 2). Our current learning topics include kinematics, Boolean logic and an introduction to computer programming [7]. Although, our ultimate goal is learning outcomes, we also take the stance that creativity is a learnable process [2] and measurable [4], and as such is an outcome itself.

*Creativity and Inspiration*

Creativity is "the ability to produce work that is both novel and appropriate" [4, p3.]. Creativity, according to Investment Theory [5], is built on six resources that fuel the creative person. It requires *intelligence* to judge ideas, *knowledge* of the domain, a *thinking style* that allows for novel thoughts, a *personality* that is willing to defy the norm, *motivation* to overcome obstacles and an *environment* that reduces risk and obstacles and provides rewards. Creativity is important as creative people add thoughts and ideas to a society, change it and drive it forward [3]. In a society unafraid of ideas, creative people are the cause of societal advancement. For this reason, creativity is a field of study important to, among others: science, art, business, mathematics and engineering. Creativity is usually not taught in schools [4, p 256] but it is a learned process that can be enhanced [4, chapter 20] and a game environment can provide positive reinforcement to encourage this.

A problem with creativity is that not all people are creative or want to create, and this could impact constructivist learning. So we focus on how to inspire creativity and creation. Inspiration then, by our definition, is providing knowledge, motivation and an environment to be creative. Specifically, we inspire creativity by: 1) teaching domain knowledge and skills to create content, 2) motivating by example quests and fun educational content, and 3) providing an environment easy to use, build and share creations.

*Minecraft as an Educational Game*

Minecraft is a 3D multiplayer virtual world constructed of 1 meter blocks that can be destroyed and harvested by players, crafted to create new tools and blocks and placed to form houses, castles, farms, walkways, art, statues, traps and machinations (see Figure 1). Gameplay is split into creative and survival modes, which allow players to focus on creating monuments unfettered by reality's limitations, fortifications designed to resist monsters or player vs player combat. Additionally, different player-run servers have different rules, goals and activities.

Michael Zyda's influential "From Visual Simulation to Virtual Reality Games" [8] article listed many of the problems facing Serious Game developers. In this article, we see why Minecraft is promising for educators. First, Mojang has announced that the modding license will be free. An active community currently is creating plugins for Minecraft, and Mojang has been quite supportive of these activities. Second, Minecraft breaks the mold regarding complexity as it paradoxically has no purpose and relies on a simple mechanism of adding and removing blocks. Educators only need to develop simple additions to the game to achieve interesting gameplay results. Third, Minecraft's networking is largely transparent and sufficient to

support the number of gamers that an online community's social networks can support. Minecraft servers are generally small clusters of communities that rely on closeness to achieve server-specific goals and to protect against grief-play. Lastly, an active modding community has created plugins and tools that allow a wide range of tailoring of a server. As well, high-fidelity graphics, sound, story and AI, cornerstones of most games, are not expected by Minecraft gamers (yet).

## The Minds of Chimera Minecraft Project

The NSF funded Minds of Chimera project at the University of Central Florida's Interactive Systems and User Experience Lab is creating a serious games platform on Minecraft. We are participating in the active modding community to extend the platform with multiple learning activities for collateral learning and enhanced end-user development, allowing for creative complex content development (see Figure 2).

The backstory is of a single world experiencing a golden age, which splits due to the player's actions. The player awakens to find time has passed and the golden age over. Three worlds remain, designed to support three different play styles, based on the heads of mythical Chimera: Ercilis the snake-headed survival world, Herfinita the goat-headed creative world and Leocitius the lion-headed questing world. Players excel in each world by surviving attacks from monsters and other players, creative and original creation, or enduring tasks created by non-player characters.

*Constructivist Play and the BSCS 5E*

Typical educational gaming engages and allows the learner to explore content, but not all games take educational gaming one step further to allow the gamer to create new content for the game, a constructivist approach. This improves the game world as well as the player's learning (see Figure 3). The benefits of our approach, contrasted with typical educational play, are demonstrated within the BSCS 5E instructional model.

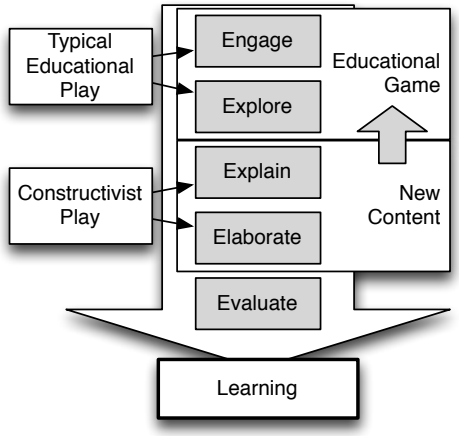


**Figure 3**. The BSCS 5E instructional model demonstrates the benefits of constructivist play in learning. It also shows the cyclical improvement of the game itself.

The BSCS 5E was created to help students learn fundamental concepts in science and other domains. It consists of five phases: *engage* – access prior knowledge and promote curiosity; *explore* - use existing knowledge to generate new ideas and explore questions; *explain* – focus on experiences and demonstrate conceptual knowledge and introduce skills and deeper understanding; *elaborate* – challenge student understanding for broader and deeper understanding; *evaluate* – assess understanding and progress towards objectives. Where typical educational play involves engaging the player and giving them a

**Figure 4**. The commercial game Minecraft was extended by us with a robot programming language CodeBlocks [7], based on the metaphor of children's block play. The CodeBlocks project seeks to increase interest in computer programming using play as the motivation. As well, players can create puzzles and challenges for other students.

game to explore some educational topic, constructivist play, where they create and build, requires students to reflect and deepen and broaden their understanding in the explain and elaborate phases.

*Instructional Content*

Three initial educational experiences are being built. The first is a Boolean logic quest line where players must power simple machines and circuits to solve quests. The second is a custom programming language created by placing blocks in the world to program simple robotic behaviors to solve quests (see Figure 4). The third is a series of conceptual physics games incorporating kinematics. The experiences we have and the additions to the Minecraft game for this content, is being provided to the community and our players, for them to create with on their own.

## Early Results and Conclusions

We have some early results from our work. First, we are creating three inspirational interventions (II), used in a longitudinal study, to demonstrate to players the possibilities of Minecraft for use in their creations. We have learned a great deal ourselves in this process of trying to be creative, which has improved the IIs. Second, we have found that computer programmers enjoy programming with CodeBlocks but it might not be optimal for them, as they already like programming languages, so hybrid approaches are being explored. For non-programmers, we have found they are quite open to computer programming using blocks, not because they like programming, but because they perceive the challenges to be akin to puzzles or mind games. This enables new approaches to teach computer programming but also new ways to reach people and interest them in computer programming.

Minecraft is a simple, fun, heavily modifiable game platform that reaches the same demographic of gamer as mainstream games. Its open world game style, open licensing and low expectations regarding story, plot and graphics, make it a platform educators can use to reach students. It has been very useful to the Minds of Chimera project and we encourage others to incorporate it in their work.

## Acknowledgements

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