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How cues of what can be done in a virtual world influence learning: An affordance perspective

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ABSTRACT

What we know about learning outcomes for collaborative tasks in virtual environments is a confusing set of results. Many organizations have been hesitant about their use of virtual environments for this reason. Virtual worlds (VWs) have received attention as environments for learning, yet little is known about their attributes, or how they affect learning in collaborative tasks. James Gibson proposed a theory of affordance to explain how cues in an environment are perceived and lead to some course of action. Based on his theory, we developed a model to describe how cues of what can be done in a VW influence learning. In doing so, we focused on the situativity afforded by VWs through context and social facilitation. We showed how VW artifacts and cues make it easier for users to understand the conditions and interactions in a VW.

We used this as a basis for predicting a user's mental state and its impact on perceived learning, learning satisfaction, and task participation. We tested our model in a lab experiment set in a VW, using a task that required collaboration between subjects. Our results supported our proposed model. Our work contributed by showing relationships between factors that are unique to a VW, but were not previously recognized. These factors suggest what can be done to influence learning in collaborative tasks in a VW.

1. Introduction

The application of virtual worlds as environments for collaboration in business has rapidly increased. Virtual worlds (VWs) are here considered to be computer-simulated three-dimensional (3D) environments where users, represented "in-world" by avatars, can communicate synchronously over a network. Tens of millions of children grow accustomed to virtual worlds, albeit through socially constrained sites, such as *Webkinz World* or *BarbieGirl*. One of these, *Club Penguin* currently has over 12 million members. As these children grow up immersed in sophisticated virtual environments, they are likely to be as comfortable using virtual worlds for learning and collaboration as today's workforce is with websites and other (2D technologies.

For tasks that involve learning through collaboration, it is important to consider the satisfaction of participants with the process of learning [11], the degree to which participants actively engage with each other in the process, and the extent to which participants learn. Traditional collaborative workspace provides tools and structures for learning (e.g., books, rooms, and lectures) that enhance the learning experience, and allow learners to become receptive (mentally 'tuning their brain') by using the structure and their artifacts. Individuals are aware of the differences between a laboratory, a library, and an auditorium by what and whom they see there. Hence, the learning space should support the learner in achieving an understanding the setting, the *context* that frames appropriate behavior, and the *interactions* that make it a learning place.

Virtual learning environments, such as learning management systems, are today predominantly static [9]. Such spaces, though providing access to information, and some interaction between participants, tend to be lacking in ways that allow individuals to have meaningful experiences. It has been assumed that virtual worlds, through their unique ability to transform spaces to places [10], can better enable learning. However, empirical research has produced mixed results about learning outcomes in virtual worlds [12]. We believe that these disparate findings can be explained by taking a *situated* perspective on learning. To be successful, learning in a virtual world must be tied to an individual's participation in learning activities that includes interactions with others as well as with the artifacts in the environment. This perspective implies that

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virtual learning environments must be designed to be interactive *social places*, rather than just in a sterile space. The nature of situated learning has been acknowledged in the computer supported collaborative work (CSCW) environments. However, this perspective has not been explicitly applied to learning in virtual worlds.

Two unique characteristics set virtual worlds apart from prior web-based communication technologies: they (i) provide a platform for designing real life-like spaces [4], and (ii) allow many-to-many interactions where avatars can "see" and interact with others logged in at the same time to the same virtual space [1,7]. Given these characteristics of virtual worlds, our research question was: "*How do characteristics of virtual worlds influence learning outcomes in tasks that involve collaboration*?"

To answer this question, we made two important steps that:

- Identified the characteristics of a VW that influence learning outcomes in collaborative tasks. We labeled these *context-* and *social-facilitation*. They are novel because they were not readily apparent in technologies prior to VWs.
- Determined how these increase perceived learning, learning satisfaction and participation in collaborative tasks in a virtual world, *Second Life*.

This suggested how and what can motivate people to learn in this new environment and their influence on learning outcomes as mediated by cognitive absorption. Apparently a focus on cues that enhance context and social facilitation is important to enhance perceived learning outcomes.

2. Literature review

Our central premise is that learning is fundamentally situated, i.e. tied to individuals' participation in learning activities that include interactions with others and material and symbolic resources in the environment [3]. This is in contrast to an individualistic perspective of learning that, by focusing on the content, downplays the role of the context. A review of learning paradigms lies beyond the scope of our study. The focus of our effort was to explore the process of learning in a virtual world environment.

2.1. Spaces and places

The concept of place originated from architecture and urban design, where it gave meaning to 3D structures (spaces). The relationship between space and place is primarily social; *spaces* are converted to *places* by peoples' interpretation of the space and their social interactions in it. A place is consequently a space with a meaning that can be private or socially shared. "Situativity" in a place is occurs through experiences from interacting in the place and with other people. A physical location (space) starts to function differently when interpretations of it evolve in the minds of its users. Conversely, two spaces may have similar spatial features but may be perceived as different places as the individuals' behavior changes. For example, an auditorium and a theatre may share similar spatial features such as lighting and orientation, but their users expect to participate in different functions in them. The distinction between spaces and places also applies to virtual worlds.

2.2. Theory of affordance

This, coming from the field of ecological psychology, provides a view of perception and action that focuses on information available in an environment. *Affordance theory* states that an environment is perceived in terms of objects and spatial relationships and also in possibilities for actions, called affordances. Properties of the environment arise in the context of their interaction with the world. Thus the difference between a chair and a table in a room is based on the possibilities they afford rather than their shapes.

This sense of affordance is reflected in everyday objects; they may attract a great deal of conscious attention or none, based on individuals' perceptions of their affordance. This is particularly true of objects that are created by human design. What they afford can influence coherence or clumsiness in a person's activities. For example, the design of a book, as opposed to a newspaper or a scroll, may afford skimming or random access by adding a thumb index or a doorknob affords opening and closing of a door. Other affordances may not have been intended by the designer; a pile of bricks and shelves may be used as a book repository. Characteristics give clues to our perception of what can and cannot be done with them— their sense of "affordance". Thus these clues in the environment indicate possibilities for action.

Affordances may help distinguish a space from a place. For an environment to be a place in which individuals can act, they must be able to perceive the possibilities for actions and interactions within it. In particular, we are interested in perceptions of the possibility of two kinds of interactions: those with the place (context facilitation), and those with others in the place (social facilitation). Such an understanding involves more than a just a perception of others' presence; it involves an understanding of their behaviors or actions. Thus the potential for interactions with others transcends perceiving their presence to understanding their behaviors and actions.

2.3. Affordances in virtual worlds

Affordance theory has been used to improve the design of virtual environments, specifically for computer supported co-operative work (CSCW) systems. We extend this idea to explain how affordances in virtual worlds occur in tasks that involve learning through collaboration.

VWs provide a way of using real life-like spaces, whereas older technologies did not allow this, thus causing de-contextualization of an individual from real life-like experiences; i.e., an environment that is primarily information- rather than experience-driven. VWs also allow many-to-many interactions in which *avatars* can "see and interact" with others. In a VW, it is through the avatar-to-avatar interactions that users' experiences are configured. Such an interaction is usually synchronous and occurs as avatars share their awareness of others and their movements. In such interaction, users have at their disposal a wide range of cues to choose among.

The unique characteristics of VWs are captured in their social and context facilitation. As individuals assign meanings to interactions with others and with elements in the environment, it is possible that they engage their cognition. Context facilitation is provided in VWs by various cues and instructions in the environment related to the task. An individual can take on, or be assigned, a definite piece of work that involves others and elements of the VW environment in which instructions can be delivered through many ways, such as text, images, audio, or 3D artifacts. Multiple avatars can access such instructions synchronously. It is through such cues that a mutual task is facilitated.

Social facilitation is supported by the way that the VW enables social interactions. Interactions with others may be through verbal and non-verbal cues. In VWs, verbal cues may include voice and text communication. Non-verbal cues may include gestures and avatar movements in. We differentiate social facilitation from social presence of a medium, which is limited to awareness of the